TECHNICAL SPECIFICATIONS

THIS VOLUME CONTAINS FOLLOWING SECTIONS

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SECTION-I: GENERAL

1.0 GENERAL:

1.1.0 PREAMBLE:

1.1.1. Bangalore Water Supply and Sewerage Board is responsible for supplying drinking water to Bangalore city. Since its inception in the year, the Board has executed many water and sewerage schemes for the city including Cauvery Water Supply Scheme (CWSS) raw water is abstracted from Cauvery River, treated at Thorekadanahalli, and is pumped to Bangalore city.

1.1.2. Under Yattinahole water supply scheme BWSSB will be receiving 0.8 TMC of water to Hesarghatta and 1.7 TMC of water to Tippagondanahalli (TG Halli) reservoir and total 2.5 TMC of water will be available for Bangalore city for drinking purpose.

1.1.3. TG Halli is situated at West of Banglore. Magadi road provides access upto TG Halli. The existing water supply scheme at TG Halli is under refurbishment under “Revival/Refurbishment of TG Halli Water Supply Scheme Phase I” project. Under this project water is treated and pumped under Stage I pumping at TG Halli to Stage II pumping at Tavarakere and then to Bangalore city.

1.1.2. At TG Halli, there was an existing 66kV switchyard with 1 incoming 66kV Bay, 2 outgoing transformer bays and 1 Voltage Transformer Bay. There were 2 nos. of 66/6.6kV, 5 MVA power transformers catering power to the Pump house and other in campus loads. The Power Transformers were installed in 1995 and serviced more than 25 Years. Under Revival/Refurbishment of TG Halli Water Supply Scheme Phase I, BWSSB proposes to upgrade existing 66kV switchyard. The work involves supply, erection, testing and commissioning of electrical equipment with associated civil works at existing 66kV switchyard at TG Halli

The bidder shall fully familiarize himself with the site conditions and General arrangements & schemes of existing substation. Though BWSSB shall endeavor to provide the information, it shall not be binding for the BWSSB to provide the same.

The bidders are advised to visit the sub-station sites and acquaint themselves with the topography, infrastructure and design philosophy.

The bidders shall be fully responsible for providing all equipments, materials, system, and services specified or otherwise which are required to complete the construction and successful commissioning of the sub-station in all respects.

2.0 SCOPE:

2.1 The detailed scope shall be as follows:

The project envisages Procurement, Erection and Commissioning of electrical equipment with associated civil works at existing 66kV switchyard, TG Halli location.

2.1.1 Supply of equipment/materials:

2.1.1.1 Design, Engineering, Manufacture, Testing at Manufacturer's works and supply of following equipment.

i. SF6 Circuit Breakers.
ii. CT's with support structures.
iii. PT's with support structures.
iv. Transformer C & R Panels.
v. NGR panels
vi. Outdoor VCB panels
vii. Isolators
viii. Lightning Arrestor
ix. Control & power cables
x. Switchyard materials like cylindrical solid core post insulator/Disc Insulators, etc.
xi. Drake ACSR conductors / Ground Wire & accessories, Insulator & Hardware clamps etc.
xii. Power connectors etc.
xiii. Earthing Materials etc.,

2.1.1.2 i) Refurbishment/Modification of existing lattice type station structures viz Towers& beams as per the single line diagrams furnished by BWSSB.

ii) Refurbishment/Modification of existing equipment/post insulator support structures (lattice type).

iii) Removing/Dismantling the existing equipment connections inside switchyard and storing them at the location shown by BWSSB.

2.1.2 Civil Works:

2.1.2.1. Leveling of the sub-station area in accordance with the levels furnished by BWSSB and consolidation.

2.1.2.2. Refurbishment / Modifications of following works

i. Foundation for Station structures and equipment / post insulator support structures
ii. RCC Cable ducts and Hume pipe cable ducts with road crossings.

iii. Anti-Weed Treatment, Final dressing of land & Gravel filling
iv. Hume pipe Culvert.
v. Waste Oil Sump
vi. Baffle wall
vii. Toe wall, chain link fence and gate.

2.1.2.3 Any other work required for successful completion of the project.

2.1.3 Laying of Earth mat:

Laying of earth mat & Earthing of Equipment.

2.1.3. Erection:

2.1.4.1. Erection of station structures, Equipment Mounting Structures, equipments like Power Transformers, Circuit breaker, CT's, PT's, LA's, etc., post insulators, Control Room Equipments like C & R, RTCC Panels, etc.

2.1.4.2. Installation of main bus & cross bus including equipment interconnections

2.1.4.3. Laying of control & power cables and Termination.

2.1.4.4. Erection of any other equipment / material required for successful completion of the project.

2.1.5 Testing & commissioning of the sub-station:

Testing & commissioning of the complete sub-Station.

2.1.6 All materials required for the Civil construction / installation work shall be supplied by the contractor. The cement and steel shall also be supplied by the contractor.

2.1.7 The contractor shall also be responsible for the overall co-ordination with internal/external agencies, project management, training of BWSSB's manpower, loading, unloading, handling, moving it to final destination for successful erection, testing and commissioning of the substation.

2.2 Typical drawings / documents:

2.2.1 The typical drawings furnished are for the guidance of the bidder. Successful bidder shall verify the drawings and furnish modified design if any. Drawings shall be submitted for approval of BWSSB, whether with or without modified designs. Only after the approval of BWSSB, the drawings shall be released for construction/installation.

2.2.4. Schedule of Quantities:

i) The detailed description of various items/equipment and civil works are indicated the schedule of requirements. Bidder is required to indicate unit rate and total price of the items under respective heads in bid proposal sheet. Bidders should include all such items in the bid proposal sheets.

ii) The quantities indicated are estimated, based on the switchyard layout. In case of towers and beams the bidder has to quote on the basis of single line diagram. The bidder has to quote on number wise, irrespective of whatever may be the weight of tower, beam.

In respect of civil works the quantities are mentioned in numbers/ metres/ Lump sum/ Kgs / M.Ton/Cmtr/Sqmtr. The same are furnished based on layout drawings.

Actual quantities executed will be measured and paid at the accepted rates. The rates shall be firm for increase in quantity to any extent.

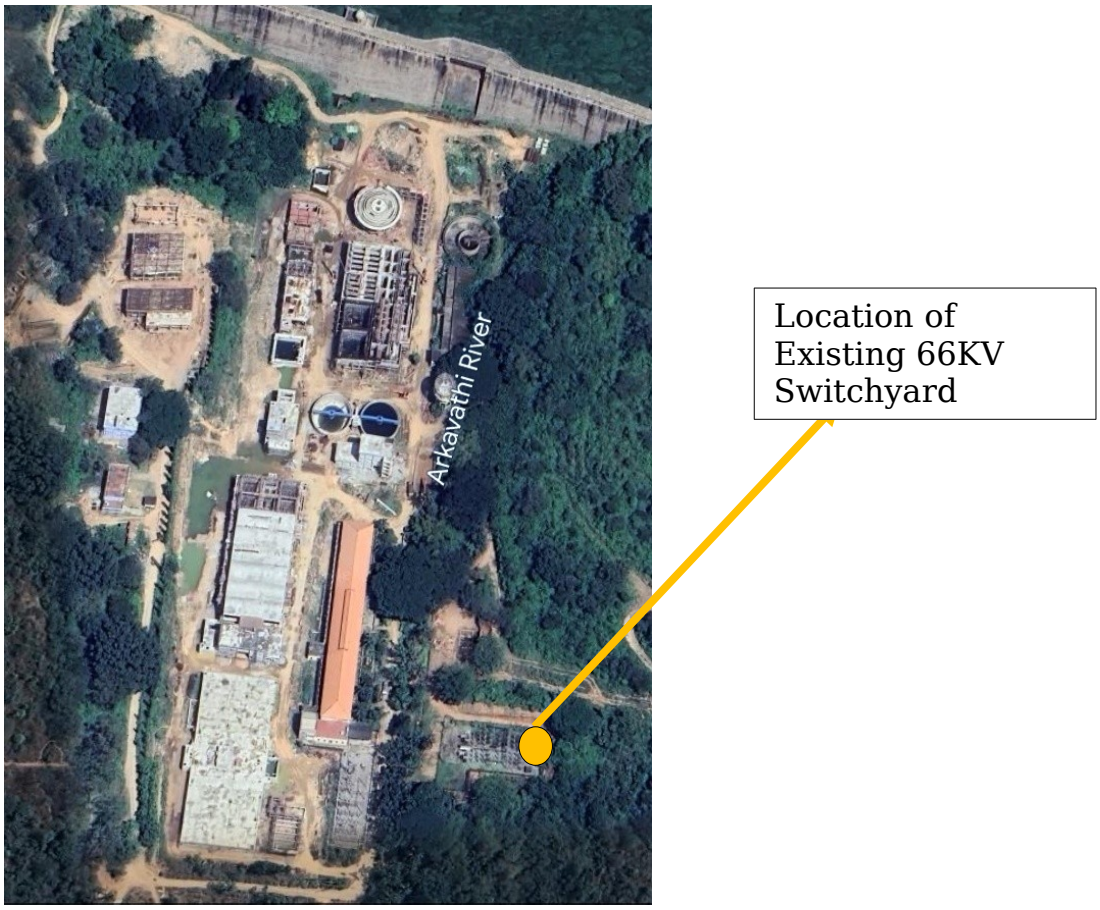
For non-tendered and extra items, the current KPWD SR applicable to the area or mutually agreed rates will be paid.

2.3 Layout arrangements:

2.3.1 The type of bus proposed is Strung made of Drake.

Location of the substation:

TG Halli *110 MLD Pump house 66kV Switchyard*



2.4 Meteorological data:

The metrological data of the substations is indicated below. However, for design purposes, ambient temperature should be considered as 50^0C.

1. Temperature — Minimum 16^0 C; Maximum 36^0 C; Average 28^0 C
2. Relative Humidity — Maximum:80%; Minimum: 10%
3. No. of Rainy days per year up to 120 days
4. Rainfall per year — 800mm
5. Altitude — 590 MSL.

2.5 Soil Data:

Soil investigation is to be got conducted by the bidder. Successful bidder shall furnish designs for civil works which

will be approved by BWSSB. Any variations of foundations etc., due to change in type of soil & consequent changes in foundation design shall be to the account of successful bidder and BWSSB will not be responsible for any extra cost.

2.6 Reference Drawings:

The typical drawings furnished are for the guidance of the bidder. Successful bidder shall verify the drawings and furnish modified design if any.The bidder shall maintain the overall dimensions of the substation, bay length, bay width, phase to earth clearance, phase to phase clearance and sectional clearance, clearances between buses, bus heights but may alter the locations of equipments to obtain the statutory electrical clearances required for the substation. The drawings enclosed give the basic conceptual scheme, layout of substation, substation buildings, associated services etc. in case of any discrepancy between the drawings and text of specification, the requirements of text shall prevail in general. The successful bidder shall furnish all the drawings for approval of BWSSB, whether with or without modified designs. Only after the approval of BWSSB, the drawings shall be released for construction/installation.

2.8 Specific Requirements:

2.9.1 The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and arrange for obtaining necessary clearance before commissioning.

2.9 **Special tools and tackles:**

The bidder may include in his proposal the deployment of all such special tools and tackles required for erection, testing, commissioning and maintenance of equipment. In addition to this the contractor shall also furnish a list of special tools and tackles for the various equipment in a manner to be referred by the BWSSB during the operation of these equipment.

2.10 Arrangements required to be made by the Contractor:

2.11.1 Electricity

The contractor shall make his own arrangements for electrical power required for construction purposes as well as for their staff & labour colony.

2.11.2 The contractor should make own arrangements for construction water supply.

The land will be handed over “as is where is condition”. The approach road and road inside the yard are in the scope of the work. The access to the site is also in the scope and shall be provided by the contractor

Payments will be regulated as per the conditions stipulated in the technical specification for civil works and other sections of the conditions of contract / specified elsewhere.

APPENDIX-1
Sheet 1 of 1
Details of Control Cables to be used for equipment

Sl. No	**Equipment**	**66kV**
1.	SF6 circuit breaker	1Rx19 core, 2.5 sq. mm
2.	Current transformer	3Rx4 core, 6 sq.mm
3.	NCT (for transformer)	1Rx2 core, 6 sq. mm
4.	Voltage transformer	3Rx4 core, 10 sq. mm
5.	Isolator	1Rx4 core, 2.5 sq. mm
6.	Transformer i. Power Transformer Marshaling box to a. Control &Relay panel b. RTCC panel&Between RTCC panels ii. AC power supply from LTAC panel to Tr. Radiator bank (cooling fan)	 4Rx19 core,2.5 sq.mm 1Rx4 core, 25 sq. mm
7.	AC power supply from AC distribution box to a. Isolators b. Breakers	 1Rx4 core, x 6 sqmm 1Rx4 core, x 6 sqmm

NOTE:

1.Material of conductor for Sl.No. 1 to 7 is copper.

2. The size of control cable mentioned above for 66kV circuit breaker is for group operating mechanism. For individual operating mechanism 1x10 core, 2.5 sq.mm cable has to be used in addition to 1x19 core.

APPENDIX-2
Sheet 1 of 1

CONTROL & RELAY PANEL: TYPES OF RELAYS TO BE PROVIDED		
APPLICATION	**RELAY**	**TYPE**
5 MVA 66/6.6KV Power Transformers (Refer Annexure CRP -2)	• Main Protection:Differential relay, REF relay high impedance,back up Protection:	Numerical Electro-Mechanical
	• Directional O/C IDMT relay(HV side & MV side)	Electro-Mechanical
	• Directional E/F IDMT relay (HV side & MV side)	Electro-Mechanical
	• Auxiliary relays:	
	• Local breaker backup relay	Electromechanical
	• Trip circuit supervision relay (HV side & MV side)	
	• Inter tripping relay	Electromechanical
	• DC supply monitoring relay	Electromechanical
	• Auxiliary relays for Buchholz trip/alarm, winding temperature high trip/alarm, etc for HV& MV	Electromechanical
	• Other annunciation relays • Timer	Electromechanical

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APPENDIX-3
Part 1 of 2
Technical Parameters of Current Transformers (Type & Rating)

Sl. No.	Technical Particulars	Type-3a	Type-3b
1	Normal System Voltage (kV)	66kV	66kV
2	Highest System Voltage (kV)	72.5kV	72.5kV
3	Frequency	50Hz	50Hz
4	Earthing	Effective	Effective
5	Basic Insulation Level (kV Peak)	325	325
6	Power Frequency withstand strength (kV RMS)	140	140
7	Short Time Current rating (kA for 1 sec)	31.5	31.5
8.	Secondary winding current rating (Amp)	1	1
9	Number of ratios	3	3
10	Ratio	400-200/1-1-1A	200-100/1-1-1A
11	Purpose for which used	66kV line using coyote	For 8MVA 66/6.6kV Transformer
12	Method of obtaining Secondary ratio	By secondary tapping without primary reconnection	By secondary tapping without primary reconnection
13	Suitability of Bimetallic terminal connector	Coyote ACSR (15.86mm Dia.)	Drake ACSR (28.14mm Dia.)

Appendix-3
Part 2 of 2

Sl. No	Type of CT's	Purpose	Rated burden	Accuracy Class	Accuracy limit factor	Instrument security factor	Knee point volts (min) VK	Secondary winding resistance max. at 75^0C RCT	Magnetizing current
A	66kV CT Type-3a		--			-			
	Core –1	Differential Scheme		PS	--	-	1600V at 400/1A 800V at 200/1A	4 Ohm at 400/1A 2 Ohm at 200/1A	30mA at Vk/4 30mA at Vk/4
	Core –2	Metering	10VA	0.2	--	≤ 5 at all ratios	--		
	Core –3	Backup protection	30VA	5P	20	--	--		--
B	66kV CT Type-3b								30mA at V_k/4
	Core –1	Differential Scheme	--	PS	--	-	800V at 200/1A	2 Ohm at 200/1A	
	Core –2	Metering	10VA	0.2	--	≤ 5 at all ratios	--		--
	Core –3	Backup protection	30VA	5P	20	--	--	--	--

SECTION – 2 GENERAL TECHNICAL REQUIREMENTS

Clause No.	Particulars
1.0	General
2.0	Instruction to Bidders
3.0	Standards
4.0	Services to be performed by the Equipment being furnished
5.0	Engineering Data
6.0	Documents
7.0	Color Scheme & codes for pipe service
8.0	Material/ Workmanship
9.0	Rating plates, Name plates labels
10.0	First Fill of Consumables, Oil & lubricants
11.0	Design improvement
12.0	Quality Assurance Program
13.0	Inspection, Testing & inspection Certificate
14.0	Tests
15.0	Packaging
16.0	Protection
17.0	Finishing of Metal Surfaces
18.0	Handling, Storing & installation
19.0	Protective guards
20.0	Design Co-ordination.
21.0	Design Co-ordination meeting

22.0 Tools & Tackles

23.0 Equipment bases

24.0 Auxiliary supply

25.0 Support Structure

26.0 Clamps & Connectors including Terminal Connectors

27.0 Control Cabinets, Junction Boxes, Terminal boxes &marshalling Boxes for outdoor equipment

28.0 Auxiliary switches

29.0 Terminal Blocks & wiring

30.0 Lamps & Sockets

31.0 Bushing, Hallow column Insulators, support insulators

32.0 Motors

33.0 Major Technical Parameters

Annexure - A Corona & Radio Interference voltage (RIV Test)

Annexure - B Seismic withstand Test procedure

Annexure – C List of specifications

1. 0 GENERAL

1.1 This section stipulates the General Technical Requirements under the Contract and will from an integral part of the Technical Specification.

1.2 The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections and is not exclusive. However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

2.0 INSTRUCTION TO BIDDERS

2.1 The bidders shall submit the technical requirements, data and information as per the technical data and information as per the technical data sheets provided in the bid documents.

2.2 The bidders shall furnish catalogues, engineering data, technical information design documents, drawings etc., fully in conformity with the technical specification.

2.3 It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Ultimate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the BWSSB. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedules of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

2.4 Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures makes shall be as defined in section –Lighting system.

2.5 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification, but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied

without any extra cost. All similar standard components/ parts of similar standard equipment provided shall be inter-changeable with one another.

2.6 Unless brought out clearly in the respective schedule of deviations, it will be considered that, the Bid Proposal scrupulously conforms compliance to the specification. The bidders must bring out all the deviations in the bid proposal.

2.7 In case there is a discrepancy between the data of offered equipment and catalogue furnished, and unless the deviation are brought out clearly in the Technical Deviation Schedule, the equipment will be deemed to conform compliance to the specification scrupulously.

3.0 STANDARDS

3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

3.2 The equipment to be supplied under this specification shall conform to latest issue with all amendments of standard specified under Annexure - C of this section as well as under respective Sections of the specification.

3.3 In addition to meeting the specific requirement called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards, which shall form an integral part of the specification.

3.4 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves but intended to compliment each other.

3.5 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

3.6 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.7 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted copies of such standards shall be submitted by the bidder.

3.8 In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in additional information schedule of Volume-III along with English language version of standard or relevant extract of the same. The

equipment conforming to standards other than IS/IEC shall be subject to BWSSB's approval.

3.9 The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

4.1 **VOID**

4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical, and meteorological conditions of the sites of installation.

4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, short circuit etc., for equipment.

4.4 The bidder shall design the various forces for which the terminal connectors of the equipment are required to withstand.

4.5 The equipment shall also comply to the following:

a) All EHV equipments shall be suitable for hot line washing.

b) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

c) All piping, if any between equipment control cabinet/ operating mechanism to marshaling box of the equipment, shall bear proper identification to facilitate the connection at site.

d) The supplier shall supply type tested equipments, materials. The type test reports shall be furnished by the supplier along with equipment/ material drawings. In the event of any discrepancy i.e., any test report not acceptable due to any design / manufacturing changes or due to non – compliance with the requirement stipulated in the technical specification or IEC/IS, same shall be carried out without any additional cost to BWSSB. Only in case of repetition of the type test, if required by the BWSSB, these tests shall be payable.

4.6 Operating times of circuit breakers, protective relays have been specified in respective sections. However, bidder is allowed to have minor variations the individual equipment timings subject to the condition that overall fault clearing time remains within 100ms.

5.0 **ENGINEERING DATA**

5.1 The furnishing of engineering data by the Contractor shall be in accordance with the Schedule for each set of equipment as specified in the Technical Specifications.

5.2 The review of these data by the BWSSB will cover only general conformance of the data to the specifications and documents,

interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the BWSSB may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated, or the accuracy of the information submitted. This review and/or approval by the BWSSB shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.3 All engineering data submitted by the Contractor after final process including review and approval by the BWSSB shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the BWSSB in Writing.

6.0 DOCUMENTS

6.1 List of Documents

6.1.1 The bidder must furnish a detailed list of drawing/documents along with the bid proposal which he intends to submit to the BWSSB after award of the contract.

6.1.2 The contractor shall necessarily submit all the drawing/documents unless anything is waived.

6.1.3 The contractor shall submit 6 (six) sets of drawing / design documents / test reports as may be required for the approval of the BWSSB.

6.2 All engineering data submitted by the contractor after final process including review and approval by the BWSSB shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the BWSSB in Writing.

6.3 Drawings

6.3.1 All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnections between various portions of equipments and any other information specifically requested in the specifications.

6.3.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the BWSSB, the unit designation, the specifications title, the specification number and the name of the Project. If

standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

6.3.3 Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the BWSSB, if so required.

6.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the BWSSB. Approval of Contractor's drawing or work by the BWSSB shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

6.5 **APPROVAL PROCEDURE**

The scheduled dates for the submission of these as well as for, any data/ information to be furnished by the BWSSB would be discussed and finalized at the time of award. The Contractor shall also submit six (6) copies of all drawings/design documents/test reports for approval of the BWSSB. The following schedule shall be followed generally for approval.

i)	Approval/ comments/ by BWSSB on initial submission	Within 2 (Two) weeks of receipt
ii)	Resubmission (whenever Required)	Within 2 (Two) weeks from Date of comments including both ways postal time).
iii)	Approval or comments	Within 2 (Two) weeks of receipt of resubmission.
iv)	Furnishing of distribution Copies	2 weeks from the date of final approval

Notwithstanding the time schedule indicated for approvals, the contractor (successful bidder) shall be responsible for completing the works in stipulated time as per approved PERT Chart.

NOTE: The contractor may please note that all resubmissions must incorporate all comments given in the prior submission by the BWSSB or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

6.7 **Other requirements of Documentation.**

6.7.1 Three sets of soft copy in CD/Pen drive and 8 sets of all drawings per substation plus one set of soft copy in CD/Pen drive and four sets of all drawings to Chief Engineer (Kaveri-O&M) BWSSB, Bangalore shall be furnished after approval of drawings.

6.7.2 The manufacturer shall also submit one video cassette (VHS-PAL) per substation and one for Chief Engineer, (Kaveri-O&M) BWSSB, Bangalore highlighting installation and maintenance techniques / requirements of Circuit Breaker arid isolators.

6.7.3 On completion of the entire works, the Contractor shall also furnish eight bound sets of as-built drawings, duly signed by the site in-charge along with 1 set of soft copy in CD/Pen drive. CD/Pen drive of substation to Chief Engineer(Kaveri-O&M),BWSSB, Bangalore containing as built drawings in Auto-cad version 14or better shall also be submitted.

6.7.4 12(8+2+2) copies of instruction/operation manuals per sub-station to Chief Engineer, (Kaveri-O&M) BWSSB, Bangalore shall also be furnished. The instruction manuals shall contain full details of drawings of equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and over hauling procedures.

6.7.5 After approval of test reports, 6(six) bound sets containing all drawings/manuals, type and routine test reports etc., along with sub-vendors's test reports for all bought out assemblies/ components/ parts including internal wiring diagrams and exploded diagrams of assemblies/components / parts, shall be furnished.

6.8 If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the BWSSB.

The contractor shall furnish to the BWSSB, spare parts catalogues also.

7.0 **COLOUR SCHEME AND CODES FOR PIPE SERVICE**

7.1 The contractor shall propose a color scheme for those equipments/ items for which the color scene has not been specified in the specification for the approval of BWSSB. The decision, of BWSSB shall be final. The scheme shall include:

- Finish colour of indoor equipment.
- Finish colour of outdoor equipment
- Finish colour of all cubicles.
- Finish colour of various auxiliary system equipment

including piping.
- Finish colour of various civil structures.

7.2 All steel structures, plates etc., shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all BWSSB's electrical equipment in BWSSB's switchyard are painted with shade 631 of IS-5. All the indoor cubicles shall also be shade 631 IS-5 and for other miscellaneous items colour scheme will be approved by the BWSSB.

8.0 MATERIAL/WORKMANSHIP

8.1 General Requirement

8.1.1 Where the specification does not contain characteristics with reference to workmanship, equipment, materials, and components of the covered Equipment, it is understood that the same must be new, of highest grade and of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

8.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the BWSSB shall decide upon the question of similarity. When required by 'the specification or when required by the BWSSB the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials, and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

8.1.3 The design of the Works shall be such that Installation, future expansions, replacements, and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed, and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will not be permitted.

8.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials, and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different piece of equipment in order to minimize spare part stocking requirements. All equipment of

the same type and rating shall be physically and electrically interchangeable.

8.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer’s recommendation(s). only first call work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/ foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be Installed at designated locations and tested for healthiness.

8.1.6 The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The contractor shall apply all operational lubricants to the equipment installed by him.

8.1.7 All oil, grease and other consumables used in the works/ equipment shall be purchased in India unless the contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case he shaft declare in the proposal, where such oil or grease is available. He shall help BWSSB in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

8.1.8 A cast iron or welded steel base plate shall be provided for all rotating equipment whichare to be installed on a concrete base unless otherwise agreed to by the BWSSB. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, if so required.

8.1.9 **Provisions for exposure to Hot and Humid climate**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air-conditioned areas shall also be of same type.

8.2.1 **Space Heaters**

8.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On-off switch and fuse shall be provided.

8.2.1.2 One or more adequately rated thermostatically controlled heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

8.2.1.3 The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life. Of the heater sheaths. of the heater sheaths or that of insulated wire or other component in the compartments.

8.2.2 Fungi Static Varnish

Besides the space heaters, special and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence of deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

8.2.3 Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

8.2.4 Degree of protection

The enclosure of the Control Cabinets, Junction boxes and Marshaling Boxes, panels etc., to be installed shall provide degree of protection as detailed here under:

a)	Installed out door	:IP	-	55
b)	Installed indoor in air-conditioned area	: IP	-	31
c)	Installed in covered area	: IP	-	52
d)	Installed indoor in non-air-conditioned area where possibility of entry of water is limited	: IP	-	41
e)	For LT switchgear (AC & DC distribution Boards)	: IP	-	52

The degree of protection shall be in accordance with IS: 13947 (Part-I) / IEC 947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

9.0 RATING PLATES, NAME PLATES AND LABELS

9.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plates of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name type or serial number together with details of the loading conditions under which the item of substation In question has been designed to operate, and such diagram plates as may be required by the BWSSB. Tile rating plate of each equipment shall be according to IEC requirement.

9.2 All such name plates, instruction plates, rating plates shall be with English inscription.

10.0 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/ brazing material for a copper piping of circuit breakers and essential chemicals etc., which will be required to put the equipment covered under the scope of the specifications, into successful Operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

11.0 DESIGN IMPROVEMENTS

11.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the BWSSB or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes, the specification shall be modified accordingly.

11.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change In. the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision there-of, shall be deemed to have been amended accordingly.

12.0 QUALITY ASSURANCE PROGRAM

12.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub- Contractor's premises or at the BWSSB's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points necessary. Such program shall be outlined by the Contractor and shall be finally accepted by the BWSSB after discussions before the award of Contract. A quality assurance program of the contractor shall generally cover the following:

a) His organization structure for the management and implementation of the
proposed quality assurance program;
b) Documentation control system;
c) qualification data for bidder's key personnel;
d) The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc;
e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
f) Control of non-conforming Items and system for corrective actions;
g) Inspection and test procedure both for manufacture and field activities;
h) Control of calibration and testing of measuring instruments and field
activities
i) System for indication and appraisal of inspection status.
j) System for quality audits
k) System for authorizing release of manufactured product to the purchaser
l) System for maintenance of records:
m) System for handling storage and delivery; and
n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality audit surveillance of the system and procedure of the contractor/ his vendor’s quality management and control activities

The BWSSB or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

12.2 **Quality assurance Document**

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment.

a) All Non-Destructive Examination procedures stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.

b) Welder and welding operator qualification certificates.

c) Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.

d) Raw material test reports oil components as specified by the specification and/or agreed to in the quality plan.

e) Stress relief time temperature charts/oil impregnation time temperature charts.

f) Factory test results for testing required as per applicable codes/mutually agreed quality plan standards refereed in the technical specification.

g) The quality plan with verification of various customer inspection points (CIP) as mutually agreed and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

13.0 **INSPECTION, TESTING & INSPECTION CERTIFICATE**

13.1 The BWSSB, his duly authorized representative and/or outside inspection agency acting on behalf of the BWSSB shall have at all reasonable times free access to the contractor's / supplier's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship at the works during its manufacture or erection. If part of the works is being manufactured of assembled at other premises or works, the contractor shall from the BWSSB or his duly authorized representative permission to inspect as if the works were manufactured or assembled on the contractors own premises or works inspection may be made at any stage of manufacture, dispatch or at site at the option of the BWSSB and the, equipment if found unsatisfactory due to bad workmanship or quality, Material is liable to be rejected.

13.2 All equipments /materials being supplied shall conform to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections. The contractor shall intimate and BWSSB the detailed program about the test at least 30 days in advance in case of domestic supplies & 45 days in advance in case of foreign supplies.

13.3 **TYPE TESTS:**

i. Only the type tested equipment/ material shall be offered.
ii. The type test reports shall not be older than five years on the day of bid opening.
iii. In case of the type test reports are older than five years on the day of bid opening, orif there is a chance in the design of the equipment/ material that has been type tested and offered now, the contractor has to conduct all the type test for the equipment/ material at no extra cost to the BWSSB.
iv. The type test charges shall be included in the total cost of the, equipment/ material and no charges will be paid extra. And will not be included for evaluation.
v. The Bidder- shall indicate the rates or all the type tests for each test or an individual equipments/ materials in the schedule which will not be considered for evaluation.

However, the BWSSB reserves the right to insist repetition of all or a few type test/ s to be conducted on the equipments/ materials though the type test reports are less than five years old. In such cases type test charges will be paid by the BWSSB at the rates indicated by the bidder in the respective schedule.

13.4 All the equipment/ material offered by the bidder shall be type tested only. The type tests reports shall not be older than 5 years on the day of bid opening. The type tests for all equipments/ materials are to be conducted by the bidder/ contractor at no extra cost to the BWSSB in case the type test reports are older than 5 years on the date of bid opening. The price of conducting type tests if any shall be included in total bid price and break up of test shall be given in the relevant schedule of Bid Proposal Sheets. Type test charges mentioned in the schedule will not be considered in bid evaluation. The BWSSB at his discretion may insist for conducting all or a few of the type tests on materials/ equipments though such type test reports are less than 5 years old on the day of bid opening. In such cases payment for those of the type tests will be paid extra as per the rates furnished in the schedule. If Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge in case of repetition.

13.5 The contractor shall give the BWSSB/ inspector thirty (30) days written notice of any material being ready for testing. Such tests shall be to the contractor's account except for the expenses of the Inspector. The BWSSB/ inspector, unless witnessing of the tests is

virtually waived, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, falling which the contractor may proceed with the test which shall be deemed to have been made in the BWSSB's/ inspector's presence and he shall forthwith onward to the BWSSB/ inspector duly certified copies of tests in triplicate.

13.6 The BWSSB/inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the contractor, of any objection to any drawings and all or any equipment an workmanship which in his opinion is not in accordance with the contract. The contractor shall give due consideration to such objections and shall either made the modifications that may be necessary to meet the said objections or shall coalman writing to the BWSSB/ inspector giving reasons therein, that no modifications are necessary to comply with the contract.

13.7 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the, BWSSB/ inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the BWSSB/ inspector, the certificate shall be issued within fifteen (15) days of receipt of contractor's test certificate by the Engineer/ inspector. Failure of the BWSSB/ inspector to issue such a certificate shall not prevent the contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the BWSSB to accept the equipment should, it, on further tests after erection, be found riot to comply with tile contract. The equipment shall be dispatched to site only after approval of test reports and issuance of delivery advice by the BWSSB.

13.8 In all cases where the contract provides for tests whether at the premises or at the works of the contractor or of any sub-contractor, the contractor except where otherwise specified shall provide free of charge such items as labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the BWSSB/inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the contract and shall give facilities to the BWSSB/ inspector or to his authorized representative to accomplish testing.

13.9 The inspection by BWSSB and issue of inspection certificate thereon shall in no way limit the liabilities and responsibilities of the contractor in respect of the agreed quality assurance program forming a part of the contract.

13.10 The BWSSB will have the right of having at his own expenses any other test(s) of reasonable nature carried out at contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

13.11 The BWSSB reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the BWSSB.

14.0 **TESTS**

14.1 **Charging**

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the BWSSB and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included In the Contractor's quality assurance program.

14.2 **Commissioning Tests**

14.2.1 The available Instrumentation and control equipment will be used during such tests and the BWSSB will calibrate all such measuring equipment and devices as far as practicable. However, immeasurable parameters shall be taken into account in a reasonable manner by the BWSSB for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The BWSSB will apply proper corrections in calculation, to take into account conditions which do not correspond to the specified conditions.

14.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

14.2.3 The specific test to be conducted on equipment have been brought out in the respective chapters of the technical specification.

14.3 The contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by 0wner on production of requisite documents.

15.0 **PACKAGING**

15.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the BWSSB, the Contractor shall also submit packing details/ associated drawing for any equipment/material under his scope of supply, to facilitate the BWSSB to repack any equipment/ material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc., shall be to t1ic account of the Contractor. BWSSB takes no responsibility of

the availability of the wagons.

16.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable device to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

17.0 FINISHING OF METAL SURFACES

17.1 GENERAL

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro, galvanized to service condition 4. All steel conductors including those used for earthing/ grounding (above ground level) shall also be galvanized according to IS: 2629.

17.2 HOT DIP GALVANISING

17.2.1 The minimum weight of the zinc coating shall be 610 gm / sq. mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6mm thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. mm minimum.

17.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spatter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

17.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

17.2.4 The galvanized steel shall be subjected to six one-minute dips in copper sulphate solution as per IS: 2633.

17.2.5 Sharp edges with radii less than 2.5min shall be able to withstand four immersions of the Standard Fleece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as relevant Indian Standard.

- Coating thickness
- Uniformity of zinc
- Addison test
- Mass of zinc coating

17.2.6 Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

17.3 PAINTING

17.3.1 All sheet steel work shall be degreased, pickled, phosphates in accordance with the IS - 6005 "Code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible) after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swap shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

17.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be scaled with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

17.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

17.3.4 The exterior colour of the paint shall be as per shade No. 697 of IS-5 and inside shall be glossy white. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

17.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc.) the procedure shall be submitted along with the Bids for BWSSB's review 8& approval.

18.0 **HANDLING, STORING AND INSTALLATION**

18.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the BWSSB or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, and square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

18.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission tile equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

18.3 In case of any doubt/ misunderstanding as to tile correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the BWSSB. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/ instructions correctly.

18.4 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustment/ alignment necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the contractor at his own expense.

18.5 Contractor shall be responsible for examining all the shipments and notify and BWSSB immediately of any damage, shortage, discrepancy etc., for the purpose of purpose of BWSSB's information only. The Contractor shall submit to the BWSSB every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, what age mid other such charges claimed by the transporters, railways etc., shall be to the account of the Contractor.

18.6 The Contractor shall be fully responsible for the equipment/ material until the same is handed over to the BWSSB in an operating condition after commissioning, Contractor shall be responsible: for the maintenance of the equipment/material while in storage as well. as after erection until taken over by BWSSB, as well as protection of the

same against theft, element of nature, corrosion, damages etc.

18.7 Where material/ equipment is unloaded by BWSSB before the contractor arrives at site or even when he is at site, BWSSB by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

18.8 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.

18.9 The word 'erection' and 'installation' used in the specification are synonymous.

18.10 All outdoor equipment except marshaling kiosk shall be suitable for hot little washing.

18.11 Exposed have parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

18.12 The minimum. phase to earth, phase to phase and section clearance for 66kVsections of the switchyard are given below:

	66kV
Phase to earth (mm)	630
Phase to phase (mm)	630
Section clearance (mm)	3000

However, the clearance as shown in the layout drawing shall be maintained.

In case of circuit breakers, the minimum phase to earth clearance (live part clearance) shall be accordance with the relevant IEC/ IS for insulation co-ordination.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

19.0 PROTECTIVE GUARDS

19.1 Suitable guards shall be provided for protection of personnel on all exposed. rotating and/or moving machine parts. An such guards with

necessary spares and accessories shall be designed for easy installation and immoral for maintenance purpose.

20.0 DESIGN CO-ORDINATION

20.1 The Contactor will be responsible for the selection and design of appropriate equipments to provide the best co-ordinate performance of the enteric system. The basic design requirements are detailed out in this specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

20.2 The Contractor has to co-ordinate designs and terminations with the agencies (if any) who are consultants/ Contractor for the BWSSB.

21.0 DESIGN CO-ORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractors and the Consultants of the BWSSB (if any) during the period of Contract. The contractor shall attend such meetings at his own cost at Bangalore as and when required and fully co-operate with such persons and agencies involved during those discussions.

22.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, disassembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to site.

23.0 EQUIPMENT BASES

A cast iron or welded steel base plate shall be provided for all rotating equipment, which is to be installed on a concrete base unless otherwise agreed to by the BWSSB. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

24.0 AUXILIARY SUPPLY

24.1 The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, lighting etc., shall be designed for the specified parameters as under. The DC supply for the instrumentation shall also conform to the parameters as indicated in the following.

Normal voltag	Variation in voltage	Frequency in Hz	Phase / wire	Neutral connection

e				
415 V	+10% or -30 %	50±5%	¾ wire	Solidly earthed
240 V	+10% or -30 %	50± 5 %	½ wire	Solidly earthed
110 V	+10% or -20%	DC		Isolated 2 wire system
48 V	+10% or -20%	DC		2 wire system (+) earthed

25.0 SUPPORT STRUCTURE:

25.1 Typical drawings of support structures are enclosed to the bid documents. Based on the equipments to be supplied, height of center line of live point indicated the layout / cross section drawings the successful bidder has to furnish the drawing for BWSSBs approval only after approval of the drawing the fabrication of structures are to be taken up. Any substructure or adopter plate required to meet the above bus termination height other than the standard structure will also have to be supplied by the Contractor as part of the equipment. All brackets, angles, stool or other members necessary for attaching the operating mechanism to the supporting structure shall be engineered and supplied as integral part of the equipment. The support structures for all equipments shall be supplied by the Contractor.

25.2 The support structures should be hot dip galvanized with minimum 610 gram / m^2 net of zinc.

25.3 In case of any deviation in this regard the bid is liable to be considered technically non-responsive and shall be liable to be rejected.

25.4 Support structure shall meet the following mandatory requirements:

25.4.1 The minimum vertical clearance from any energized metal part of the equipment / post insulator from Ground level shall be 5.5, 4.6, & 4.25 meters for 245KV, 123KV & 72.5KV equipments respectively.

25.4.2 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

26.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS:

26.1 All power clamps and connectors shall conform to IS: 5561 & NEMA CC1and shall be made of materials listed below:

a)	For connecting ACSR conductors shall be of fired wedge type	Aluminum alloy casting, conforming to designation A6 of IS:617 and shall be tested for all test as per IS:617
b)	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2 mm thick bimetallic liner and shall be tested as per IS:617
c	For connecting G.I.	Galvanized mild steel shield wire

)		
d)	i) Bolts, nuts &plain, washers ii) Spring washers for items ‘a’ to ‘c’	i) Electro-galvanized for sizes below M12, for others hot dip galvanized. ii) Electro-galvanized mild steel suitable for at least service condition-3 as per IS:1573

26.2 Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment. Shall be either expansion, sliding or rigid type.

The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

26.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

26.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.

26.5 No current carrying part of any clamp shall be less than 10mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2mm thickness shall be cast integral with aluminum body for Bi-metallic clamps.

26.6 Lateral load deflection test shall be carried out as an acceptance test. The test procedure and accepted norms shall be mutually discussed and agreed to.

26.7 All casting shall be free from blow holes, Surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

26. 8 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (flexed/sliding) type connection as required. In all the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.

26.9 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/ connector, except on the hardware.

26.10 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

26.11 **VOID**

26. 12 **TESTS**

26.12.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Type tests/special tests shall be carried out on three samples.

The following is the list of type tests.

1) Temperature rise test (maximum temperature rise allowed is 35ºCover 50ºC ambient)

2) Short times current test.

3) Resistance test and tensile test.

27.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

27.1 All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS: 5039 / IS: 8623, IEC-439, as applicable, and the clauses given below:

27.2 Control cabinets junction. boxes, marshaling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least, 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shaft be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness

27.3 The enclosures of the control cabinets, junction boxes, terminal boxes &marshaling boxes shall provide a degree of protection of not less than (IP:53). After protection degree. test of marshaling kiosk, 2.5 kV rms for 1(one) minute, insulation resistance and functional test

should have been conducted. In case these tests have not been carried out during IP : 55 test, then the contractor shall carry out the IP-55 test along with. these tests, at his cost.

27.4 Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

27.5 Cabinet/ boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere the quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.

27.6 All doors removable covers and plates shall be gasket all a-round with suitably profiled Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged/ cracked during the ten years of operation of the equipment or its major overhaul whichever is earlier. All gasket surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating louvers, if provided, shall have screen and fillers. The screen shall be fine wire mesh made of brass.

27.7 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weatherproof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet.

Suitable cable gland plate projecting at least 150mm above the base of the marshaling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel-plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing amour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

27.8 A 240V, single phase, 50Hz, 15-amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

27.9 For illumination of Control cabinet a 15 Watts CFL shall be provided.

27.10 All control switches shall be of rotary switch type band Toggle/piano switches shall not be accepted.

27.11 **Earthing**

Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star of self-etching washer. Earthing of hinged door shall be done by using a separate earth wire.

27.12 **Tests**

a) The marshaling kiosks shall be subject to routine tests as per IS:5039.

b) The following routine tests shall also be conducted.

i) Check for wiring

ii) Visual and dimension check

Marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/ connection/ ferruling by pasting the same on the inside of the door.

28.0 **Auxiliary Switches**

The auxiliary switch shall confirm to the following type tests:

a) Electrical endurance test - A minimum of 2000 operation for 2A DC with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual; defects/ temperature rise test.
b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.
c) Heat run test on contacts.
d) IR/HV test etc.

29.0 **TERMINAL BLOCKS AND WIRING**

29. 1 Control and instrument leads from the switchboards or from other equipment will be brought to Perennial boxes or control cabinets in conduits. All inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

29.2 Terminal blocks shall be 1100V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of molded piece, complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-

disconnecting stud type equivalent to Elmex type.

CATM4 Phoenix cage clamp type of Wage or equivalent. The insulating material of terminal block shall be Nylon 6.6, which shall be free of halogens, fluorocarbons etc.

29.3 Terminal blocks for current transformers and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short-circuiting and earthing facilities.

29.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

29.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel-plated copper or zinc plated steel shall also be acceptable.

29.6 The terminal blocks shall be of extendable design.

29.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

29.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

29.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a) All circuits except CT circuits : Minimum of two of 2.5 Sq. mm copper flexible.

b) All CT circuits : : Minimum of 4 Nos. of 10Sq. mm copper flexible

29.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinets is live.

29.11 At least 20% spare terminals shall be provided on each panel/ cubicle/ box and these spare terminals shall be uniformly distributed on all terminal rows.

29.12 There shall be minimum clearance of 250mm between the First / Last column of terminal block and the associated cable gland plate. Also,

the clearance between two columns of terminal blocks shall be minimum of 150mm. CT / PT marshalling box shall have terminals in vertical columns 3 Nos. for 3 Core CT's / PT's. Between two columns sufficient space of 150mm to be provided to facilitate wiring.

29.13 The Contractor shall furnish all wire, conduits and terminals for the necessary inter phase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.

29.14 All input and output, terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

30.0 LAMPS AND SOCKETS

30.1 **Lamps:**
All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

30.2 **Sockets**
All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

30.3 **Hand Lamp:**
A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF switch for connection of hand lamps.

30.4 **Interior lighting:**
Each panel shall be provided with a LED lighting fixture of Standard Indian type or l5watts compact fluorescent tube rated for 240 Volts, single Phase, 50 Hz supply for the, interior illumination of the panel during maintained. The Fittings shall be complete with switch fuse unit and switching of fittings shall be controlled by the respective panel door switch.

30.5 **Switches and Fuses:**

30.5.1 Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch fuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by fuses.

30.5.2 All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately Shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the. fuse rating and voltage.

30.5.3 All control switches shall be of rotary type and toggle/Plano switches shall not be accepted.

31.0 Bushings, hollow Column Insulators, Support Insulators:

31.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS: 5621.The support insulators shall be manufactured and tested as per 1S-2544/1EC 168 and IEC273. The insulators shall also conform to IEC 815 as applicable.

31.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from land nations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

31.3 Glazing of the porcelain shall be uniform brown in color, free from blisters, burrs and similar other defects.

31.4 Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions. Under which they will be used.

31.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushing-, when operating at the normal rated voltage.

31.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The, design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

31.7 All iron parts shall be hot dip galvanized and all joints shall be airtight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by matching. Insulators/bushing design shall. be such as to ensure a uniform compressive pressure on the joints.

31.8 **Tests:**

In accordance with the requirements stipulated under Clause No.13.0 of this Section bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2009 &IS: 2544.

31.9 Technical parameters of bushing/hollow column insulators/support insulators:

Sl.No	**Particulars**	**For 72.5 KV system**
1	Rated voltage (kV)	72.5
2	Impulse withstand	±325
3	Switching surge with stand voltage (dry and wet) (kVP)	-
4	Power frequency withstand voltage (dry and wet)kV rms	140
5	Total creepage distance (mm)	1813
6	Pollution class-III heavy (as per IEC 71) and as specified in section-2 for all class of equipment.	-
7	Insulator shall also meet requirement of relevant standards for 66 kV, as applicable having alternate long & short sheds	-

32.0 MOTORS

Motors shall be "'Squirrel Cage" three, phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required to the driven equipment and shall conform to type tests and shall be subjected to routine test as per applicable standards. The motors shall be of approved make

32.1 Enclosures

a) Motors to be installed outdoors without enclosure shall have hose proof enclosure equivalent to IP 55 as Per IS:4691. For motors to be installed indoor i.e. inside a box, the motor enclosures, shall be dust proof equivalent. to IP 44 as per IS:4691.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casting.
d) Motors weighing more than 25Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

32.2 Operational Features

a) Continuous motor rating (name plate rating) shall be at least ten (10) percent. above the maximum load demand of the driven equipment at design duty point and the motor shall not be overloaded at any operating point of' driven equipment that will rise in service.
b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars, as given in Clause 21.4.0 of this section.

32.3 Starting Requirements:

a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
b) Motors shall be capable of withstanding the electrodynamics stresses and heating imposed if it is started at a voltage of 110% of the rated value.
c) the locked rotor current shall not exceed six (six) times the rated full l load current for all motors, subject to tolerance as, give in IS325.
d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 24.0 shall be capable of withstanding at least two successive starts from cold condition at room temperature and one start from hot condition without injurious heating and winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition,
e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shall. which shall remain closed for speed lower than 20% arid open for speeds above 20% of the rated. speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

32.4 **Running Requirements:**

a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified. The limits specified in IS:325 (for 3- phase induction motors)after adjustment due to increase ambient temperature specified

b) The double amplitude of motor vibration shall be within the limits specified in IS 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

c) All the induction motors slit-All be capable of running at. 80% of rated voltage for a period or 5 minutes wit-it rated load commencing from hot condition.

32.5 **TESTING AND COMMISSIONING**

An indicatives list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P / instructions of the equipment contractor or BWSSB without any extra cost to the BWSSB. The Contractor Shall arrange all instruments required for Conducting these tests along with calibration certificates and shall furnish the list, of instruments to the BWSSB for approval.

a) Insulation resistance.

33.0 MAJOR TECHNICAL PARAMETERS

For Circuit Breaker and Isolator

34.0 MAJOR TECHNICAL PARAMETERS

FOR OTHER PARAMETERS REFER CHAPTER – CIRCUIT BREAKER AND CHAPTER - ISOLATOR OF SECTION-4.

FOR CT / SA

Rated voltage kV (rms)	72.5	12
Rated frequency (Hz)	50	50
No. of poles	1	1
Design ambient Temperature (deg C)	50	50
Rated Insulation levels	72.5kV	12kV

1) Full wave impulsewithstand voltage
(1.2/50 micro sec.)

-between line terminalsand ground	325	75
-for arresters housing	1050	
2) One minute power frequency dry and wet withstand voltage.		
-between line terminalsand ground	140	28
-For arrester housing	140	
Minimum creep age distance:		
Phase to ground (mm)	1813	300
System neutral earthing	Effectively earthed	Effectively earthed
Seismic acceleration	---	----
Partial discharge for: Surge arrester at 1.05		
COV	Not exceeding 50pc	Not exceeding 50pc
For CT/ PT	Not exceeding 10pc	Not exceeding 10pc

ANNEXURE - A
CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 **General:**

Unless otherwise stipulated, all equipment (except Power transformers) together with its associated connectors, where applicable, shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage

2.0 Test levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special- Committee on Radio Interference (CISPR) publication 16-1 (1993) Part - 1. The measuring circuit shall preferably be tuned to frequency with 10% 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts,

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of RIV, temporary additional external corona. shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% of the specified PIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage. is listed in the detailed specification Together. with maximizing permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation of equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noises meter. A calibration procedure of the frequency to which noise meter shall be

tuned shall establish the ratio of voltages at the high voltage terminal to voltage read by noise meter.

4.0 **Test methods for visible Corona**

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise value. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. The voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona. extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positives polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltages steps i.e. 85%, 100%, 115% and 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection a-rid comparison with conditions as determined form direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energies connectors. The photographs shall be framed such that, test-. object, essentially, fills the frame with no cut-off'.

4.1 The test shall be recorded on each photograph. Additional photographs shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location fibrin the photographic evidence.

4.2 In addition to photographs of the test object at least four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects'. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by BWSSB's inspector, after determining the best camera locations by trial energization of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction Voltage testing maybe permitted at the discretion of BWSSB's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records:

In addition to the information previously mentioned and these requirements specified as per CISPR or NEMA 1.07 -1961 the following data shall be included in test report:

a) Background noise before and after test.
b) Detailed procedure of application of test voltage.
c) Measurement's of RIV levels expressed in micro volts at each level.
d) Results and observations with regard to location and type of interference sources detected at each step.
e) Test voltage shall be recorded when measured RIV passes through 100 microvolts iii each direction.
f) Onset arid extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE- B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment shall be carried out along with supporting structure.

The Bidder shall arrange to transport the structure from his Supplier's premises/sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the BWSSB. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the BWSSB.

ANNEXURE- C

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

Indian Electricity Rules
Indian Electricity (Supply) Act
Indian Factories Act

IS-5 1994	Colours for Ready Mixed Paints and Enamels.
IS-335	New insulating Oils.
IS-617	Aluminum and Aluminum Alloy Ingots and Castings for General Engineering Purposes
13-1448 (P1 to P145)	Methods of Test for Petroleumand its Products.
S-2071 (PI to P3)	Methods of High Voltage Testing.
IS- 12063	Classification of degrees ofprotection provided by enclosures of electrical equipment .
IS-2165	
P 1: 1997	Insulation Coordination.
P2: 1983	
IS-2362	Determination of Water by Karl fisher Method.
IS-3043	Code of Practice for Earthing
IS-3637	Gas Operated Relays
IS-6103	Method of Test for Specific Resistance (Resistivity) ofElectrical Insulating Liquids.
IS-6104	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	Method of test for power factor Dielectric Constant of Electrical Insulating Liquids.
IS-6792	Method for determination of Electric strength of insulating oils.
IS-5578	Guide for making of insulated conductors.

IS- 11353:1985 &Identification of conductors	Guide for uniform system of marking apparatus terminals.
IS-8263 Insulators.	Method for Radio Interference Test on High voltage
IS-9224 (Part 1, 2 & 4)	Low Voltage Fuses
IEC-60060 (Part I to P,-1)	High Voltage test Techniques
IEC-60068	Environmental Test
IEC-60117	Graphical Symbols
IEC- 60156 Electrical	Method for the Determination of the Strength of Insulation Oils.
IEC-60270	Partial Discharge Measurements.
IEC-60296 Insulating Oils for Transformers	Specification for Unused Mineral and Switchgear.
IEC-60376	Specification and Acceptance of New Sulphur Hex fluoride.
IEC-60437	Radio Interference Test on High Voltage Insulators.
IEC-60506	Switching Impulse Test on High Voltage Insulators.
IEC-60507	Artificial Pollution Tests on High Voltage Insulators to be used on AC systems.
1EC-60694	Common Specification for High Voltage Switchgear & Control gear Standards.
IEC-60815	Guide for the Selection of Insulators in respect of Polluted Conditions.
IEC-60865 (1994)(Pl 8& P2) effects.	Short Circuit Current Calculation of
ANSI-C. 1./NFPA.70	National Electrical Code
ANSI-C37.90A	Guide for Surge Withstand

	Capability (SWC) tests
ANSI-C63-2 1,	Specification for Electromagnetic Noise and
C63.3	Field Strength Instrumentation 10 kHz to I GHz
C36.4ANSI-C68. I	Technique for Dielectric Tests
ANSI-C76. I/EEE21	Standard General Requirements and Test
	procedure for Outdoor Apparatus Bushings.
ANSI-SI 4	Specification for Sound Level Meters
ANSI-Y32-2/C337.2-	Drawing Symbols
ANSI-Z55. 1.1	Gray Finishes for Industrial Apparatus and Equipment
No.61.Light	Gray
NEMA- 1071 -	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-11 -	General Standards for Industrial Control and Systems Part ICSI-109
CISPR- I	Specification for CISPR Radio Interference Measuring Apparatus for thefrequency range 0. 15 MHz to 30 MHz
CSA-Z299.1-1978h -	Quality Assurance Program Requirements
CSA-Z299.2-1979h -	Quality Control Program Requirements
CSA-Z299.3-1979h -	Quality Verification Program Requirements
CSA-Z299.4-1979h -	Inspection ProgramRequirements
BS- 148	Insulating oil for Transformers, switchgear.

TRANSFORMERS

IS- 10028 (Part 2 & 3)	Code of practice for selection, installation & maintenance of Transformers(P1: 1993),(P3:1991)
IS-2026 (Pl. to P4)	Power Transformers
IS-3347 (Part1 to Part8)	Dimensions for Porcelain

	transformer Bushings for use in lightly polluted atmospheres.
IS-3639 Transformers	Fittings and Accessories forPower
IS-6600 Transformers.	Guide for Loading of Oilimmersed
IEC-60076 (Part1 to Part5)	Power Transformers
IEC-60214	On Load Tap-Chargers.
IEC-60354	Loading Guide for Oil - Immersed power transformers
IEC-60076	Determination of Transformer & Reactor sound levels
ANSI-C571280 -	General Requirements for Distribution, Power and Regulation Transformers
ANSI-C571,290 -	Test code for Distribution, Power and Regulation Transformers
ANSI-C5792	Guide for Loading Oil-Immersed lower Transformers upto and including 100MVA with 55^0 C or 65^0 C Winding Rise
ANSI-CG, IEEE-4	Standard Techniques for High Voltage Testing
NEMA-TR- 1	Transformers, Regulators and Reactors

CIRCUIT BREAKERS

IEC-62271-100	High Voltage Alternating Current Circuit Breakers
IEC-60427	Synthetic Testing of High Voltage alternating Current Circuit Breakers.
IEC-61624	Pressurized hollow Column Insulator

CURRENT TRANSFORMER, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS

IS-2705 (PI to P4)	Current Transformers.

IS-3156 (PI to P4)	Voltage Transformers
IS-4379	identification of the content of Industrial Gas Cylinders
IEC- 60044-1	Curent Transformers.
IEC- 60044-2	Voltage Transformers.
IE C-60358	Coupling capacitors andcapacitor dividers.
IEC-60044-4	Instrument Transformers Measurement of Partial Discharges
IEC-60481 (1974)	Coupling devices for Power Line Carrier Systems.
ANSI-C5713	Requirements for Instrument Transformers
ANSI-C92.2	Power Line Coupling Voltage Transformers
ANSI-C93.1	Requirements for Power Line Carrier Coupling Capacitor

BUSHING

IS- 2099	Bushings for Alternating Voltages above 1000V
IEC-60137	Insulated Bushings for Alternating Voltages above 1000V

SURGE ARRESTERS

IS-3070 (Part2) (1993)	Lightning arrestors for alternating current systems Metal oxide lightening arrestors without gaps.
IEC-60099-4	Metal oxide Surge Arrestors without gaps.
IEC-60099-5	Selection and application recommendation
ANSI-C62.1	IEE Standards for Surge Arrestors for AC Power

	Circuits
NEMA-LA 1	Surge Arrestors

CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248, IS-3231,3231(P-3)	Electrical relays for power System protection
ISAA;5039	Distributed pillars for Voltages not Exceeding 1000 Volts.
IEC-60068.2.2	Basic environmental testing Procedures Part 2: Test B: Dry heat.
IEC-60529	Degree of Protection provided by enclosures.
IEC- 60947-4-1	Low voltage Switchgear and Controlgear
IEC- 158 (upto P3-1985)	Low Voltage Control Gear Contractors.
IEC-60439 (P 1 8& 2)	Low Voltage Switchgear and control gear assemblies
IEC-61095	Electromechanical Contactor for household and similar purpose
ANSI-C37.20	Switchgear assemblies, including metal enclosed bus.
ANSI-C37.50	Test Procedures for Low Voltage Alternating Current Power Circuit Breakers
ANSI-C39	Electric Measuring instrument
ANSI-C83	Components for Electric Equipment
IS:8623: (Part I to 3)	Specification for Switchgear Control Assemblies.
NEMA-AB	Moulded Case Circuit and Systems
NEMA-CS	Industrial Controls and Systems
NEMA-PB- I	Panel boards

NEMA-SG-5	Low voltage Power Circuit Breakers
NEMA-SG-3	Power Switchgear Assemblies
NEMA-SO-6	Power Switching Equipment
NEMA-5E-3	Motor Control Centers
1248 (PI to P9)	Direct acting indicating analogue electrical measuring instruments & their accessories.

DISCONNECTING SWITCHES

IEC-60129	Alternating Current Disconnections (Isolators) and Earthing switches
IEC-60265 (Part 1 and part 2)	High Voltage Switches
ANSI-C37.32	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high Voltage Air Switches, Bus supports and switch accessories.
ANSI-C37.34	Test Code for high voltage air Switches
NEMA-SG6	Power switching equipment

TELECOMMUNICATIONS AND LINE TRAP

		CEA Regulations
IS-8792	-	Line traps for AC power system.
IS-8793	-	Methods of tests for line traps.
IS-8997	-	Coupling devices for PLC systems
IS-8998	-	Methods of test for coupling devices for PLC Systems.
IEC-60353		Line traps for AC power systems.
IEC-60481		Coupling Devices for power line

	carrier systems.
IEC-60495	Single sideboard power line carrier terminals
IEC-60683	Planning of (single side-band) power line carrier systems.
CIGRE	Teleportation report by Committee 34 & 35.
CIGRE	Guide, on Power line, carrier 1979.
CCIR	International Radio Consultative Committee
EIA	Electric Industries Association

PROTECTION AND CONTROL EQUIPMENT

IEC-60051 : (P1 to P9)	Recommendations for Direct Acting, indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to part 23)	Electric relays.
IEC-60297 (P1 to P4) series.	Dimensions of mechanical structures of the 482.6mm (19 inches)
IEC-60359	Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	Symbols for Alternating- Current Electricity meters.
IEC-60447	Man machine interface (MMI) - Actuating principles.
IEC-60521	Class 0.5, 1 and 2 alternating current watt hour meters
IEC-60547	Modular plug-in Unit and standard 19-inchi rack mounting unit based on NIM standard (for electronic nuclear instruments)
ANSI-81	Screw threads

ANSI-B 18	Bolts and Nuts
ANSI-C37.1	Relays, Station Controls etc.
ANSI-C37.2	Manual and automatic station control, supervisory and associated telemetering equipment
ANSIA-37-2	Relays and relay system associated with electric power apparatus
ANSI-C39. I	Requirement for electrical analog indicating instatements

MOTORS

IS-325 (199 1)	Three phase induction motors.
IS-4691	Degree of protection provided by enclosure for rotating electrical machinery.
IECI-60034 (P1 to P19)	Rotating Electrical Machines
IEC-Document (Central Office)	2 Three phase induction motors
NEMA-MGI	Motors and Generators
Electronic equipment and components	
MIL-21b MIL-833 MIL-2750	
IEC-60068 (P1 to P5)	Environmental testing
IEC-60326 (P1 to P2)	: Printed boards.

MATERIAL AND WORKMANSHIP STANDARDS

IS- 1363 (P I to P3)	Hexagon head bolts, screws and nuts of product grade C.
IS- 1364 (P1 to P5)	Hexagon head bolts, screws and nuts of products grades A and B.
IS-3138 (199 1)	Hexagonal Bolts and Nuts (M42 to M 150)
ISO-898	Fasteners: Bolts, screws and

	studs
ASTM	Specification and tests for Materials
CLAMPS & CONNECTORS	
IS-5561	Electric power connectors.
NEMA-CCI	Electric Power connectors for sub station
NEMA-CC3	Connectors for Use between aluminum or aluminum- copper Overhead Conductors
BUS HARDWARE AND INSULATORS	
IS: 2121	Fittings for aluminum and steel cored aluminum conductors for overhead power lines.
IS-731	Porcelains insulators for overhead power lines with a nominal voltage 1000 V.
IS-2486 (P1 to P4)	Insulator fittings for overhead power lines with a nominal voltage greater than 1000V.
IEC-60120	Dimensions of Ball and Socket Couplings of string insulator Unit
IEC- 60137	Insulated bushings for alternating volt-ages above 1000V.
IEC-60168	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000V.
IEC-60233	Tests on Hollow insulators for use in electrical equipment.
IEC-60273	Characteristics of indoor and outdoor post insulators for systems with nominal Voltages greater than 1000V.
IEC-60305	Insulators for overhead lines with

		nominal voltage above 1000V ceramic or glass insulator unit's for AC systems Characteristics of String Insulator units of the cap and pin type.
IEC-372		Locking devices for ball and socket couplingsof string insulator units : dimensions and tests.
IEC-60383 (PI & P2)		Insulators for overhead lines with a nominal voltage above 1000V.
IEC-60433	-	characteristics of string insulator units of the long rod type.
lEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29	-	Wet process porcelain insulators
ANSI-C29. I	-	Test methods for electrical power Insulators
ANSI-C92.2		For insulators, wet-process porcelains and toughened glass suspension type
ANSI-C29.8		For wet-process porcelain insulators apparatus, post-type
ANSI-0.8		Iron and steel hardware
CISPR-7B		Recommendations of the CISPR tolerances of form and of Position, Part 1.)
ASTM A-1 53		Zinc, coating hot dip on iron and steel hardware

STRAIN AND RIGID BUS-CONDUCTOR

IS-2678	Dimensions &, tolerance for Wrought. Aluminium and Aluminium Alloys drawn round type.
IS-5082	Wrought Aluminium and Aluminium Alloy Bars, Rods, Tubes and Sections for Electrical purposes.

ASTM-B 230-82	Aluminium 1350 H 19 Wire for electrical purpose
ASTM-B 231-81	Concentric - lay - stranded, aluminimum 1350 conductors
ASTM-B 221	Aluminium - Alloy extruded bar, road, wire, shape
ASTM-B 236-83	Aluminium bar-, for electrical purpose (bus bars)
ASTM-B 317-83	Aluminium - Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

BATTERIES AND BATTERIES CHARGER (Not in the Scope)

BATTERY

IS 1652	Stationary Cells & Batteries, Lead-acid type (with Plante positive plates)
IS 1146	Rubber & Plastic containers for Lead-acid storage Batteries
IS 6071	Synthetic separators for Lead-Acid Batteries
IS 266	Specification for Sulphuric acid
IS 1069	Specifications for Water for Storage Batteries
IS 3116	Specification for Sealing compound for Lead-Acid Batteries
IS 1248	Indicating Instruments

BATTERY CHARGER

IS 3895	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS 4540	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.
IS 6619	Safety code for Semiconductor Rectifier Equipment
IS 2026	Power Transformers

IS 2959	AC Contactors for Voltages not exceeding 1000 V
IS 1248	Indicating Instruments
IS 2208	HRC Fuses
IS 13947 (Part –3)	Air Break Switches, air break disconnectors& fuse combination units for voltage not exceeding 1000 V AC or 1200 V DC.
IS 2147	Degree of protection provided by enclosures for low voltage switchgear and controlgear
IS 6005	Code of practice for phosphating of Iron and Steel
IS 3231	Electrical relays for power system protection
IS 3842	Electrical relay for AC system
IS 5	Colours for ready mix paint
IEEE 484	Recommended design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE 485	Sizing large lead storage batteries for generating stations and substations.

WIRES AND CABLES

ASTMD-2863	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	PVC Insulated cables for working voltages upto and including 1100 Volts
IS 1255	Code of practice for installation and maintenance

	of Power cables upto and including 33KV
IS-1554 (Pl and P2) cables part	PVC insulated (heavy duty) electric working voltage upto and including 1100V. Part (2) for working voltage from 3.3 KV upto and including 11KV.
IS-3975	Mild steel wires, formed wires and tapes for armouring of cables.
IS 1753	Aluminium conductor for insulated cable
IS 2982	Copper conductor in insulated cables
IS 3961 (P1 to P5)	Recommended current rating of cables
IS-5831	PVC insulating and sheath of electric cables.
IS-6380	Elastometric insulating and sheath of electric cables.
IS-7098	Cross linked polyethylene insulated PVC sheathed cables for working voltage from 3.3KV upto, and including 33 KV
IS-8130	conductors for insulated electrical cables and flexible cords.
IS-10418	Specification for drums for electric cables
IEC-60096 (Part 0 to Part P4)	Radio Frequency cables.
lEC- 60183	Guide to the Selection of High voltage Cables.
IFC-60189 (Pl to P7)	Low frequency cables and wires, with PVC insulation and PVC sheath.
IEC-60227 (PI to P7) voltages	Polyvinyl Chloride insulated of rated tip to mid in-including 450/750 V.

IEC-60228	Conductors of insulated cables
IEC-60230	impulse tests on cables and their accessories.
IEC-60287 (P1 to P3)	Calculation of the continuous current rating of cables (100% load factor).
IEC-60304 -	Standard colours for insulation for low-frequency cables and wires.
IEC-60331 -	Fire resisting characteristics of Electrical cables.
IEC-60332 (Pl to P3) -	Tests on electric cables under fire conditions.
IEC-60502 -	Extruded solid dielectric insulated power cables for rated voltages from 1KV up to 30KV.
IEC-754 (PI and P2)	Tests oil gases evolved during Combustion of electric cables.
NEMA-WCI-	Asbestos and Asbestos -Varnished cloth and asbestos-Thermoplastic insulated wire and cable
NEMA-WC2 -	Steel Armour and associated covering for impregnated - paper -insulated cables
NEMA-WC3	Rubber insulated wire and cable for transmission and distribution of electrical energy.
NEMA-WC5	Thermoplastic insulated wire and cables for the transmission and distribution of electrical energy
NEMA-WC7	Cross-liked thermo setting polyethylene insulated wire and cable for the transmission and distribution of electric energy
NEMA-WC8	EthyIcne-propylene- rubber-insulated wire and cable for the and distribution of electrical energy
NEMA-W67	Cross-linked-thermo setting

	Polyethylene
(IPCEA, S-66-52,M)	Insulated wire and cable for the transmission and distribution of electrical energy
IPCEA S-61-402	Thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy
ASTMD-2843	Standard test methods for density of smoke from burning or decomposition of plastics.
IEEE-48	Pot heads
IEEE-383	Standards for type tests of 1E class of electrical cables, field splicers and connection for nuclear power generating stations.

GALVANIZING

IS-209	Zinc Ingot
IS-2629	Recommended Practice for Hot-Dip galvanizing on iron and steel.
IS-2633	Methods for testing uniformity of coating of zinc coated articles.
ASTM-A- 123	Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A- 153	Specification for Zinc Coating (Hot Dip) on iron and steel hardware.
ASTM-A-239 spot in a Iron or steel	Test method for locating the thinnest Zinc (Galvanized) coating on articles by the preece test (Copper sulfated dip).
ASTM-A- 121-77	Zinc-coated (Galvanized) steel barbed wire

PAINTING

IS-6005 (199 1)	Code of practice for phosphating of iron and steel
ANSI-Z551	Gray finishes for industrial apparatus and equipment
SSPEC	Steel structure painting council

FIRE PROTECTION (Not in the Scope)
Fire protection manual issued by Tariff Advisor Committee (TAC) of India

NFPA	National Fire Protection Association
NBFU	National Board of Fire Underwriters
IS 636	Non percolating flexible fire fighting delivery note
IS-554 (1990)	Dimensions for pipe threads where pressure tight joints are required To the threads.
IS-638 (1993)	Sheet rubber jointing and rubber insertion jointing.
IS-778 (1990)	Copper alloy gate, globe and check values for water works purposes
IS-780 (1990)	Sluice valves for water-works purposes (50 to 300 mm size)
IS- 1536 (1993)	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
IS- 1538 (1993)	Cast iron fittings for pressure pipes for water gas and sweage.
IS-1703 (1989)	Copper alloy bar valves (horizontal plunge r type) for water supply fittings.
IS-2379 (1990)	Colour code for identification of pipe lines.
10-26-13 (111 to 113:1990)	Dimensions for pipe thread for fastening purpose.
IS-2685 (1992)	Code of practice for selection, installation and

	maintenance of sluice valves.
IS-2906 (1990)	Specification for sluice valves for water works purposes (350 to 1200 mm size).
IS-3389 (199 1)	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 to 2032 mm outside diameter).
IS-4038 (1990)	Foot valves for water works purposes.
IS-4927 (1992)	Unlined flax canvas hose for firefighting.
IS-5312 (P1 and P2: 1991)	Swing check type reflux (non-return) valves
IS- 3095 (1991)	Butterfly valves for general purpose

STEEL STRUCTURES

IS-228	Method of chemical analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P 1 to 3)	Code of practice for use. of structural steel in overhead transmission line towers.
IS-806	Code of practice for use of steel tubes in general building construction
IS-808	Dimensions for hot rolled steel beam, column channel and angle sections.
IS-814	Covered electrodes for manual are welding of carbon of carbon manganese steel.
IS-816	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	Code of practice for training and testing of metal arc-,welder, Part 1: Manual Metal arc welding
IS-875 (PI to P4)	Code of practice for. design loads

	(other than earthquake) for buildings and structures.
IS- 116 1	Steel tubes for structural purposes.
IS- 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
IS-1363 (PI to P3)	Hexagonal head-bolts, screws 7 nuts of products grade C.
IS 1364	Hexagonal head bolts, screws and nuts of product grade C
IS-1367 (P I to P18)	Technical supply condition for threaded fasteners
IS- 1599 -	Methods for bend test.
IS- 1608 -	Method for tensile testing of steel products.
IS- 1893 -	Criteria for earthquake resistant design of structures.
IS- 1978	Line pipe.
IS-2062	Steel for general structural purposes.
IS-2595	Codes of practice for Radiographic testing
IS-3063	Single coil rectangular section spring washers for bolts, nuts and screws.
IS-9-3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods.
IS-7205	Safety code for erection of structural steel work.
IS-9595	Recommendations for Metal arc welding of carbon and carbon manganese steels.

ANSI-B 18.2.1	Inch series square and Hexagonal bolts and screws
ANSI-B 18.2.2	Square and hexagonal nuts
ANSI-G8.14	Round head bolts
ASTM-A6	Specification for General Requirements for rolled steel plates, shapes sheet piling and bars of structural use
ASTM-A36	Specification of structural steel
ASTM-A17	Specification for malleable iron castings
ASTM-A143	Practice for safeguarding against embalmment of Hot Galvanized structural steel products and procedure for detecting embrilement
ASTM-A242	Specification for high Strength low alloy structural steel
ASTM-A283	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441	Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572	Specification for High strength low alloy Columbium-Vanadium
AWS DI-O	Code for welding in building construction welding inspection
AWS DI-1	Structural welding code
AISC	American institute of steel Construction
NEMA-CG 1	Manufactured graphite electrodes

PIPING AND PRESSURE VESSELS

IS-1239 (Part 1 8& 2) -	Mild steel tubes, tubular and other wrought steel fittings
IS-3589 -	Seamless Electrically welded steel pipes for water, gas and sewage.
IS-6392 -	Steel pipe flanges
ASME	Boiler and pressure vessel code
AST'M-AI-20	Specification for pipe steel, brick and hot dipped, zinc-coated welded and seamless
ASTM-A53	Specification for pipe, steel, black and hot dipped, zinc-coated welded and seamless
ASTM-AI06	Seamless carbon steel pipe for high temperature service
ASTM-A284	Low and intermediate tensile strength carbon-silicon steel plates for machine parts and general construction.
ASTM-A234	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-AI81	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	Forgings, carbon steel for piping Components
ASTM-A307	Carbon steel externally threaded standard fasteners
ASTM-A193	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	Flat rolled electrical steel for magnetic applications
ASTM-A197	Cupola malleable iron
ANSI-B2. 1	Pipe threads (Except dry seal-)

ANSI-B 16. 1	Cast iron pipe flanges and glanged fitting class 25,125, 250 and 800
ANSI-B 16. 1	Malieable iron threaded fittings, class 150 and 300
ANSI-B 16.5	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B 16.9	Factory-made wrought steel butt welding fittings
ANSI-B 16. 11	Forged steel fittings, socket welding and threaded
ANSI-B 16.14	Ferrous pipe plug, bushings and locknuts with pipe 'threads
ANSI-B 16.2 5	Butt welding ends
ANSI-B 18.1.1	Fire hose couplings screw thread.
ANSI-B 18.2.1	Inch series square and. hexagonal bolts and screws
ANSI-B 18-2.2	Square and hexagonal nuts
ANSI-B 18.2 1. 1	Lock washers
ANSI-B 18-21.2	Plain washers
ANSI-B3 1. 1	Power piping
ANSI-B36. 10	Welded and seamless wrought steel pipe
ANSI-B36.9	Stainless steel pipe

OTHER CIVIL WORKS STANDARDS

IS-26 9	33 grade ordinary Portland Cement.
IS-2721 -	Galvanized steel chain link fence fabric
IS-278 -	Galvanized steel barbed wire for fencing.
IS-383	Coarse and fine aggregates from natural sources for concrete.

IS-432 (PI and P2)	Mild steel and medium tensile steel bars and hard-dawn steel wire for concrete reinforcement.
IS -456	Code of practice for plain and reinforced concrete.
IS-516 -	Method of test for strength of Concrete
IS-800 -	Code. of practice for construction in steel.
IS-806	Steel tubes for structural Purposes:
IS- 1172	Basic requirements for water supply, drainage and sanitation.
IS-1199	Methods of sampling and analysis of concrete.
IS- 1566	Hard-dawn steel wire fabric for concrete reinforcement.
IS- 1742	Code of Practice for Building drainage.
IS- 1785	Plain hard-drawn steel wire for pre-stressed concrete
IS- 1786	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	Methods of sampling Foundry sands.
IS- 1893	Criteria for- earthquake resistant design of structures.
IS-2062	Steel for general structural purposes.
IS-2064	Selection, installation and maintenance of sanitary appliances-code of practices.
IS-2065	Code of practice for water supply in buildings.
IS-2090	High tension steel bars used in

	pre stressed concrete.
IS-2140	Standard galvanized steel wire for fencing.
8S-2470 (P1 8& P2 1990)	Code of practice for installation of septic tanks.
IS-2514	Concrete vibrating tables.
IS-2645	Integral cement waterproofing compounds.
IS-3025 (Part 1 to Part 48)	Methods of sampling and test (Physical and chemical) for water mid waste water.
IS-4091	Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part I to P5)	Code of practice for ancillary structures in sewerage system.
IS-4990	Plywood for concrete shuttering work.
IS-5600	Sewage and drainage pumps.

National building code of India 1970

USBR E12	Earth Manual by United States department of theinterior Bureau of Reclamation
ASTM-A392-81	Zinc/coated steel chain link fence fabric.
ASTM-D 1557-80	test for Moisture-density relation of soils using 10-1b (4.5kg rame land 18-in.(457mm)Drop
ASTM-D 1.586	Penetration Test and Split-Barrel. Sampling of Soils
ASTM-D2040-69	Test Method for Relative Density ofCohesion less Soils
ASTM-D2435	Undrained Strengths of Cohesive Soils in Triaxial compression.

BS-5075	Specification for accelerating admixtures, retarding Admixtures and Water Reducing Admixtures.	Part I

ACSR CONDUCTOR

Indian Standard	Title	International standard
IS:6745 (1990)	Methods for Determination of mass of Zinc coating on zinc coated Iron and Steel Articles	BS:443-1969
IS:8263 (1990)	Methods for Radio Interference Test on High Voltages Insulators	IEC:437-1973 ASTM: 107-1964 CISPR
IS:209 (1992)	Zinc Ingot	BS:3436-1961
IS:398 (1992) Part - V (1992)	Aluminium Conductorsfor overhead Transmission purposes Aluminum Conductors galvanized steel reinforced extra high voltage (400KV and above)	IEC:209-1966 BS:215 (Part-11) 1970 JEC:209-1966 BS:215 (Part-11) 1970
IS: 1778-1980	Reels and Drums for Bare Conductors	ISO/R89-1959
IS: 152 1 (199 1)	Method for Tensile Testing of steel wire	ISO/R89-1959
IS:2629 (1990)	Recommended practice for Hot dip Galvanizing on Iron and steel	
IS:2633 (1992)	Method for Testing Uniformity of coating of zinc Coated Articles.	
IS:4826 (1992)	Hot dip galvanized coatings on round steel wires	ASTMA-472-729

GALVANIZED STEEL EARTHWIRE

IS: 1521 (199 1)	Method for Tensile Testing of Steel Wire	ISOIR: 1959
IS: 1778 (1980)	Reels and Drums for More Conductors	

IS:2629 (1990)	Recommended practice for Hot Dip Galvanizing on Iron and steel.	
IS:2633 (1992)	Methods for testing Uniformity of coating of Zinc Coated Articles.	
IS:4826 (1992)	Hot dip Galvanized Coatings on Round Steel	ASTM:A 475-72a BS-443-1969

Indian Standard	Title	International standard
IS:6745 (1990)	Method for Determination of mass of Zinc coated Iron and Steel Articles.	BS:443-1969
IS:209 (1992)	Zinc ingot	BS:3436-1961
IS:398 (11) to P5 1992)	Aluminum conductors for overhead transmission purposes.	BS:215 (Pfu,t-I1)

SECTION – 3 TRANSFORMERS

- NOT APPLICABLE

SECTION – 4(A) CIRCUIT BREAKERS

TECHNICAL SPECIFICATION

FOR

72.5 kV SF6 CIRCUIT BREAKERS

FOR

66kV SUB-STATIONS

TECHNICAL SPECIFICATION
FOR 72.5kVSF6 CIRUIT BREAKERS FOR SUB-STATIONS OF BWSSB

Clause No.	Particulars
1.0.0	**Scope**
2.0.0	**Service Conditions**
3.0.0	**Standards**
4.0.0	**Principal Parameters**
5.0.0	**Technical Requirements**
6.0.0	**Tests**
7.0.0	**Inspection**
8.0.0	**Quality Assurance Plan**
9.0.0	**Experience for Participating in Tenders**
10.0.0	**Performance Guarantee**
11.0.0	**Documentation & Drawings**
12.0.0	**Test Reports**
13.0.0	**Packaging & Forwarding**
14.0.0	**Supervision of Erection, Testing & Commissioning**
15.0.0	**Training of Engineers**
16.0.0	**Recommended Spares**
17.0.0	**Schedules**
18.0.0	**List of Annexures**

TECHNICAL SPECIFICATION FOR 72.5kV SF6 CIRUIT BREAKERS FOR SUB-STATIONS.

1.0.0 SCOPE

1.2.0 This specification covers design, manufacture, assembly, testing at manufacturer's works / testing laboratories before supply, inspection, packing and delivery of outdoor type circuit breakers, erection and commissioning of circuit breakers of rated insulation class of 72.5kV. The Circuit Breakers shall be of Sulphur hexafluoride (SF6) type and shall be complete with all the accessories and auxiliary equipments and mounting structures required for their satisfactory operation in BWSSB sub-stations.

1.3.0 It is not the intent to specify completely here in all the details of design and construction of the circuit breaker. However, the breaker shall conform, in all respects to high standards of engineering, design and workmanship as listed in clause No. 3.0. It shall be capable of performing in continuous commercial operation up to the supplier's guarantee in a manner acceptable to the purchaser who will interpret the meanings of drawings and specifications and shall have power to reject any work or material which, in his judgment, is not in accordance therewith. The circuit breaker offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of supplier's supply, irrespective of whether those are specifically brought out in this specification and / or in the commercial order or not.

2.0.0 SERVICE CONDITIONS

2.1.0 Environmental Conditions :

The circuit breakers and accessories to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

a) Maximum ambient air temperature [Deg. C] - 50
b) Minimum ambient air temperature [Deg. C] - 5
c) Average daily ambient air temperature [Deg. C] - 30
d) Relative humidity [%] - 10 to 100
e) Average rainfall per annum [mm] - 1000-3000/5000
f) Maximum altitude above mean sea level [Mtrs] - 1000
g) Maximum wind pressure [Kg. / Sq. M] - 150
h) Isoceraunic level [stormy days per year] - 46
i) Seismic level [horizontal acceleration] - 0.3g
j) Moderately hot and humid tropical climate, conducive to rust and fungus growth.

2.2.0 AUXILIARY POWER SUPPLY

The Rating, quality and location of electrical supply system that will be made available by the purchaser for operation of the circuit breaker are described below. The auxiliary electrical equipments

provided by the tenderer for specified operation of the circuit breaker, shall be suitable for operation on the same.

2.2.1 Ratings :

i) For power devices (like drive motors)	415V, 3 phase, 4 wire, 50 Hz neutral grounded AC supply
ii) For AC Control & Protective devices, lighting fixtures, space heaters and f.h.p. motors	240V, single phase, 2 wire, 50 Hz, AC supply with one point grounded.
iii) For DC alarm, control and protective devices	2 wire ungrounded DC supply from batteries & battery charger. i) 110V DC for 66 kV Sub-Stations. The ripple content in the DC supply from the battery charger will be less than 2%

2.2.2 Variation :

The above supply systems may have variations as follows :

1) AC supply voltage variation 2) Frequency variation	+10% to –30% $\pm$5%
3) DC supply voltage variation	+10% to –20%

3.1.0 STANDARDS:

3.2.0 The circuit breakers shall conform to the latest revision and amendments of standards as given below :

Sl. No.	Standard ref. No.	Title
1	IS :13607	Ready mixed paints, brushings, finishing etc.,
2	IS : 325	Specification for 3 phase induction motor
3	IS : 2099 IEC :60137	High voltage porcelain bushing
4	IS : 2147	Degree of protection provided for enclosures for low voltage switch gear and control gear
5	IS : 2629	Recommended practice for hot dip galvanizing of iron and steel
6	IS :13947	General requirement of switch gear and control gear for voltages not exceeding 1000V
7	IS : 4379	Identification of contents of industrial gas cylinders
8	IS : 5561	Electrical power connectors
9	IS :7285	High pressure cylinder in which SF6 gas is transported and stored at site.
10	IS : 13118	Specification for HV AC circuit breakers
11	CIGRE working group report No.	Switching over-voltages in EHV and UHV systems with special reference to closing and re-closing transmission lines.

	13-02-1973	
12	CEA Regulations	
13	IEC : 62271-100	Specification for AC circuit breakers
14	IEC :60060-3 & IS: 2071	High voltage test techniques
15	IEC :60071&IS:2165	Insulation coordination, terms, definitions, principles and rules
16	IEC : 60270	Partial discharge measurements
17	IEC : 60376	Specification and acceptance of new supply of SF6
18	IEC : 60694	Common clauses for high voltage switchgear and control gear controls.
19	IEC 60427	Synthetic testing of high voltage alternating current circuit breaker

3.2.0 Equipments meeting with the stipulations of equivalent IEC, ANCI, CSA, DIN standards, which ensure equal or better quality than the standards listed above shall also be acceptable. In such a case the bidder should submit along with his offer, two copies of such standards in authentic English translation, if the language of the standard is other than English. In case of dispute, the stipulations in the English translation, submitted by the bidder, shall prevail. Further, in the event of the conflict between the stipulations of the standard adopted by the bidder and the corresponding Indian standard specifications, the stipulation of Indian standards specification shall prevail.

4.0.0 PRINCIPAL PARAMETERS:
The breakers shall conform to the specific Technical requirements specified here under:

Sl. No.	Item	Requirements
1	Rated voltage of the breaker (KV rms)	72.5
2	Nominal system voltage (KV)	66
3	Highest system voltage (KV)	72.5
4	System frequency	←----------50 Hz ----------→
5	System Neutral grounding	←-----effectively earthed------→
6	Continuous current rating (A) (at site conditions)	1250
7	Installation (Indoor / Outdoor)	←---------Outdoor ----------→
8	Type of breaker	←---------SF6 ----------→
9	Mounting	On hot dip galvanized steel support structure or on the operating mechanism box, as the case may be, to be supplied by the bidder.
10	Number of poles	3
11	Type of operation	Threesingle poles gang operated

12	Phase to phase spacing in the switchyard i.e., preferred inter pole spacing for breaker (in mm)	2000
13	Required ground clearance from the lowest live part of the breaker from the ground level(mm). (If both the terminals are not in the same horizontal plane then the above mentioned heights are to be reckoned for lower terminal)	4250/ strung bus
14	Height of concrete plinth above ground level (mm)	300
15	Minimum height of the lowest part of the support insulator from ground level (mm)	2500
16	Operating mechanism	←spring operated / semi pneumatic / pneumatic refer clause 5.12 →
17	Type of tripping	← Trip free →
18	Auto re-closing duty	Three phase ThreeThree phasephase
19	Rated operating duty cycle	0-0.3 seconds – CO-3-minutes – CO- as per IEC-62271-100
20	First pole to clear factor	1.5
21	Max. closing time (ms)	150
22	Max. total break time at rated breaking capacity (ms)	60
23	1.2 / 50 micro second impulse withstand voltage: i. to earth (KVP) ii. Across open contacts: (Impulse on one terminal and power frequency voltage on opposite terminal (KVP))	 325 325
24	One minute power frequency withstand voltage (KV rms)	140
25	Max. radio interference voltage (micro volts)	--- --- ---
26	Rated breaking current capacity: i. Line charging at rated voltage (A) ii. Small inductive current (A) iii. Cable charging at rated voltage (A) Note:- The rated cable charging breaking current for circuit breakers used for switching underground cables shall be	 10 0.5 to 10 without switching over voltage exceeding 2.0 PU. 125

	confirmed by the bidder iv. Short Circuit current a)A.C Component (KA rms) For stations in Bangalore b) Percentage D.C component	 31.5 1 sec 40KA 1 Sec corresponding to minimum opening time as per IEC-62271-100
27	Rated short circuit making current capacity (KA peak)	78.75
28	Permissible limits of temperature rise	Refer clause No. 5.11.0
29	Max. acceptable difference in the instants of closing / opening of contacts: i. Within a pole (ms) ii. Between poles (ms)	 --- 10
30	Minimum creepage distance of support insulator (mm)	1815
31	Rating of auxiliary contact	10A at 110 volts D.C
32	Breaking capacity of auxiliary contacts	2A D.C with the circuit time constant not less than 20 ms.
33	Noise level at base and up to 50 meters	140 db(max)

5.0.0 Technical requirement:

5.1.0 General

5.1.1 Circuit breaker offered shall be Sulphur hexafluoride (SF6) type of 72.5kV rating. SF6 gas shall serve as the quenching medium and insulation between open contacts of the circuit breakers.

5.1.2 Similar parts of the breaker, especially the removable ones, shall be freely interchangeable without the necessity of any modification at site.

5.1.3 The circuit breaker shall comprise of three identical single pole units.For 72.5kVcircuit breaker the type of operation shall be three single poles gang operated suitable for three pole re-closing. These units shall be linked together electrically /pneumatically/mechanically complete in all respects.

Complete circuit breaker with all the necessary items for successful operation shall be supplied, including but not limited to the following.

a) Breaker assemblies with bases, support structures for Circuit Breaker as well as for individual control cabinet/central control cabinet and foundation bolts for main structure as well as

individual control cabinet / central control cabinet (except concrete foundations), terminals and operating mechanism.

b) Compressed SF6 gas, Pneumatic system complete including compressors, tanks, piping, fittings, valves and controls and necessary supports for inter-pole piping for pneumatic systems.

c) One central control cabinet for each breaker with all the required electrical devices mounted therein and the necessary terminal blocks for termination of inter-pole wiring.

d) Instruments, gauges and other devices for SF6 gas pressure, pneumatic pressure supervision.

e) All necessary Parts to provide a complete and operatable circuit breaker installation such as main equipment, terminal, control parts, connectors and other devices, whether specifically called for herein or not,

5.1.4 The circuit breaker shall be designed for three pole re-closing for 72.5KV rating with an operating sequence and timing as specified in clause 4.0 “Principal Parameters".

5.1.5 The support structure of circuit breaker and that of control cabinet shall be hot dip galvanized.

5.1.6 Circuit Breaker shall be suitable for hot line washing.

5.1.7 Facility for up-rating:

The design of the breaker shall be such that it should be possible to up-rate the rupturing capacity of the breakers at a later date either by adding additional interrupter assemblies or parallel resistors, etc. the supplier should highlight in his offer, the special features available for up-rating the breakers offered.

5.2.0 CONTACTS:

5.2.1 All making and breaking contacts shall be sealed free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacements due to excessive burnings will not be necessary. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

5.2.2 Main contacts shall be first to open and the last to close so that there will be little contact burning and wear. If arcing contacts are used they shall be first to close and the last to open. Tips of arcing contacts and main contacts shall be silver plated or made of superior material like graphite or tungsten alloy.

5.2.3 Any device provided for voltage grading to damp oscillations or to prevent re-strike prior to the complete interruption of the circuit or to limit over voltages on closing shall have a life expectancy comparable to that of the breaker as a whole.

5.2.4 Breakers shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life of the material used. The temperature shall not exceed that indicated in IEC-56 under specified ambient conditions.

5.2.5 Contacts shall be kept permanently under pressure of SF6 gas. The gap between the open contacts shall be such that it can withstand at-least the rated phase toground voltage continuously at zero gauge pressure of SF6 gas due to its leakage.

5.2.6 If multi-break interrupters are used these shall be so designed and augmented that a uniform voltage distribution is developed across them. Calculations/ test reports in support of the same shall be furnished along with the bid. The thermal and voltage withstands of the grading elements shall be adequate for the service conditions and duty specified.

5.2.7 The inside operating rod or insulated fiber glass connecting rods wherever used, shall be sturdy and shall not break during the entire life period of the breaker. The insulated rods shall have anti-tracking quality towards electrical stresses.

5.3.0 PORCELAIN HOUSING:

5.3.1 The porcelain housing for the interrupter shall be of a single piece construction without any joint. It shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength. Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles (fog).

5.4.0 SUPPORT INSULATORS:

5.4.1 In the live type tank construction, the tank containing SF6 gas and interrupters which is at the potential of the circuit to which circuit breaker is connected when the breaker is in service, shall be insulated from earth by providing suitable support insulators.

5.4.2 The basic insulation level of the external insulator supports shall be 550KV for 123KV, 325KV for 72.5KV and 170KV for 36KV system and shall be suitable for installation in contaminated atmosphere. The porcelain used shall be homogenous and free from cavities or other flaws. They shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation under conditions specified above. All bushings of identical ratings shall be interchangeable. The puncture strength of the bushings shall be greater than the flashover value.
The bushings shall be entirely free from radio disturbances when operating at a voltage up to 10% above rated voltage and also be free from external and internal corona.

5.5.0 ADDITIONAL REQUIREMENTS:

a) The Circuit breakers shall be single pressure type and shall utilize puffer cylinder for interrupting circuit currents. Each SF6 circuit breaker pole shall be provided with its own self obtained gas system. The design and construction of the circuit breaker shall be such that there is no possibility of gas leakage and ingress of moisture. There should not be any condensation of SF6 gas on the internal insulating surface of the circuit breaker.

b) All gasketted surfaces shall be smooth, straight and reinforced, if necessary to minimize distortion and to make a tight seal, the operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals, Double-0-ring seals shall be provided on each static joint.

c) In the interrupter assembly there shall be an absorbing product box to eliminate SF6 decomposition products and moisture. The material used in the construction of the circuit breakers shall be fully compatible with SF6 gas.

d) The SF6 gas density monitor shall be adequately temperature compensated.

The density monitor shall meet the following requirements.

i. It should be possible to dismantle the density monitor for checking / replacement without draining the SF6 gas by using suitable interlocked non-return couplings.

ii. It shall damp the pressure pulsation while filling the gas in service so that the flickering of the pressure switch contacts does not take place.

iii. A pressure indicator shall also be supplied.

e) VOID

f) Facility shall also be provided to reduce the gas pressure within the breaker to a value not exceeding 8millibars within 4 hours or less. Each circuit breaker shall be capable of withstanding this degree of vacuum without distortion or failure of any part.

g) Sufficient SF6 gas shall be provided to fill all the circuit breakers installed. In addition to this 20% of the total gas requirement shall be supplied as spare requirements.

h) Provisions shall be made for attaching an operation analyzer after installation at site to record contact travel, speed and making measurement of operation timings, pre-insertion timing of closing resistor and synchronization of contacts.

5.6.0 SULPHUR HEXAFLOURIDE GAS (SF6 GAS):

a) The SF6 gas shall comply with IEC-60376, 376A AND 376B and be suitable in all respects for use in the switch gear under the worst operating conditions.

b) The high pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with requirements of the following standards and regulations :

IS: 4379 -Identification of the contents of industrial gas cylinders

IS: 7311 -Seamless high carbon steel cylinders for permanent and high pressure liquefiable gases.

The cylinders shall also meet Indian Boiler regulations.

5.6.1 The SF6 gas shall have the following characteristics :

Sl. No.	**Particulars**	**Characteristics**
1.	Physical properties	Colourless, odourless, non-toxic and nonflammable
2.	Density at 20ºC and 1 bar	6.08 grams/ litre
3.	Electric strength	2 ½ times that of Nitrogen
4.	Compatibility	Up to temperature of about 180ºC its compatibility with material used in electrical construction shall be similar to that of Nitrogen.
5.	Toxic impurities	SF6 gas shall comply with the requirements of the test as per clause 22 of IEC : 487 – 1971. Impurity or group of impurities — Maximum permitted concentration % by Mass CF4 — 0.05% Oxygen + Nitrogen (Air) — 0.05% Water — 15PPm Acidity expressed as HF — 0.3ppm Hydrolysable fluorides expressed as HF — 1.0ppm Oil — Content substantially free from oil There shall be no traces of carbon or carbon oxides what so ever in the gas.
6.	Preferred size of cylinders	10 and 40 liters
7.	Test pressure of	According to gas cylinder rules 1981

	cylinder	and to comply with IS : 7285-1974.
8.	Maximum filling ratio for tropical country	According to gas cylinder rules 1981 and to comply with IS : 7285 – 1974
9.	TESTS: a) Toxicity test b) Water content and condensation temperature c) Carbon tetra fluoride oxygen and nitrogen contents d) Hydrolysable Fluoride content. e) Acidity f) Oil content	 Clause No.22 of IEC 60376 – 1974 Clause Nos. 23, 24, 25 and 26 of IEC :60 376B 1974 Clause Nos. 27, 28, 29, 30 and 31 of IEC :60 376 – 1976. Clause Nos. 32,33,34,35,36 and 42 of IEC: 60376 – 1976 Clause Nos. 38, 39,40,41 and 42 of IEC :60376 –1976 Section 13 of IEC60 376A - 1973

5.6.2 The gas shall be non-flammable, nontoxic, odourless, inert and thermally stable and shall have a high specific heat to enable quick removal of the heat produced by the arc.

5.6.3 The deterioration or decomposition of the SF6 gas due to arcing should be practically negligible and even when decomposed it should recombine immediately to form the original SF6 gas within an extremely short time such as one micro-sec.

5.7.0 a) SF6 breaker shall be so designed that upon loss of pressure the gap between open contacts shall be adequate to withstand at least the rated voltage at atmospheric pressure of gas.

b) Bidder shall clearly bring out in his offer, the precautions to be taken in the use of SF6 breaker.

c) Following features shall be provided for monitoring of SF6 gas in the breaker:

1) SF6 gas density meter with two potential free contacts of suitable rating. One of these contacts shall be used for annunciation of low density. The other contact shall be used by the bidder to ensure breaker lockout in the event of low SF6 gas pressure. The successful bidder shall furnish a chart showing relation between pressure and density of SF6 gas, as well as settings for alarm and lockout.

2) Suitable pressure gauges shall be provided for SF6 gas, pneumatic air, hydraulic oil as applicable. Gauge dials shall be clearly visible with naked eye to an observer standing on ground.

3) Adequate number of pressure switches, shall be provided for monitoring pressure of SF6 gas. The pressure switches shall be provided with sufficient number of potential free NO &

NC contacts for purchaser's use in control, protection and alarm circuits.

d) For 72.5kV CB’s common gas system with pressure gauge, density monitor, gas filling portwith non-return valve, piping between poles should be provided.

5.8.0 DUTY REQUIREMENTS:

5.8.1 Recovery voltage and power factor:

The circuit breaker shall be capable of interrupting rated power with recovery voltage equal to the rated maximum line to line service voltage at rated frequency and at a power factor not exceeding 0.15.

5.8.2 Re-striking voltage:

a) The circuit breaker shall be totally re-strike free under all duty conditions, opening resistors shall not be used.
b) The measures adopted for ensuring proper operation at high rate of rise of re-striking voltage and for limiting the actual voltage values across the breakers shall be described in the tender. The type, characteristics and rating of the resistor used if any to shunt the breaker contacts and of the auxiliary switching devices used for interrupting the resistor current shall be clearly stated.

5.8.3 The circuit breaker shall meet the duty requirements for any type of fault or fault location, for line and cable charging and dropping when used on an effectively grounded system and perform make and break operations as per stipulated duty cycles satisfactorily.

5.8.4 The circuit breaker shall be capable of :

i) Interrupting the steady and transient magnetizing current of 72.5kV class 8.0 MVA Power Transformers.
ii) Interrupting line charging current and cable charging current as given in Clause 4.0 "Principal parameters" of this specification.
The circuit breaker shall be designed so as to be capable of interrupting line charging and cable charging currents without undue rise in the voltage on the supply side and without any re-strike and without showing signs of undue stress. The guaranteed over voltage which will not be exceeded while interrupting the line charging current and cable charging current as specified in IEC – 62271-100 (having a time constant not less than 0.1Sec.) shall be indicated in the tender.
The over voltage caused while interrupting the above charging currents, shall preferably not exceed the designed switching over voltage specified in table IX of IEC – 62271-100.

The results of the tests along with copies of the oscillographs, conducted to prove the ability of the breakers to interrupt these and lower line charging current values shall be furnished with the tender.

iii) Clearing short line faults:
Clearing short line faults (Kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.
The interrupting capacity of the breaker for Kilometric faults (short line faults) shall be the same as the rated capacity. The details of tests conducted for proving the capabilities of the breaker under Kilometric fault conditions shall also be stated in the tender.

iv) Breaking inductive currents of 0.5 to 10A without switching over voltage exceeding 2.0 p.u. as given in clause 4.0 " Principal Parameters"

v) The breaker shall be capable of satisfactory operation even under conditions of phase opposition that may arise due to faulty synchronizing. The maximum power which the breakers can satisfactorily interrupt under phase opposition shall be stated in the tender.

5.8.5 The critical current, which gives the longest arc duration at lock out pressure of extinguishing medium and the arc duration shall be indicated.

5.8.6 The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energization of lines with trapped charges. The breaker shall also withstand the voltage specified in clause 4.0 "Principal Parameters" of this specification.

5.9.0 TOTAL BREAK TIME :

5.9.1 The "Total Break Time" as specified in Clause 4.0 "Principal Parameters" of this section shall not be exceeded under any of the following duties:

i) Basic short circuit Test duties as per IEC – 62271-100 (with TRV as per I EC – 62271-100).

ii) Short line fault L90, L75 (with TRV as per IEC – 62271-100).

5.9.2 The Bidder may please note that there is only one specified break time of the breaker which shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, (70-110%) pneumatic / arc extinguishing medium pressure etc., while furnishing the proof for the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between contacts within a pole or between poles and show how it is covered in the guaranteed total break time.

5.9.3 The values guaranteed shall be supported with the type test reports.

5.10.0 INSULATION OF CIRCUIT BREAKER:

5.10.1 The insulation to ground, the insulation between open contacts and the insulation between phases of the completely assembled circuit breaker shall be capable of withstanding satisfactorily dielectric test voltages corresponding to the basic insulation level as specified in Clause 4.0 "Principal Parameters"

5.10.2 If SF6 gas is utilized for insulating purposes across open contacts, the insulation strength of the break at the lowest permissible pressure and at atmospheric pressure shall be stated.

5.11.0 LIMITS OF TEMPERATURE RISE:

The temperature rise on any part of equipment shall not exceed the maximum temperature rise specified below under the conditions specified in test clauses. The permissible temperature rise indicated is for a maximum ambient temperature of 50 deg C. If the maximum ambient temperature rises, permissible values shall be reduced accordingly.

Nature of the part of the material and of the dielectric	Maximum permissible temperature (deg. C)	Values of Temperature rise at a max. air temperature not exceeding 50deg C
1) Contacts (see note-3) Bare Copper and Bare copper alloy		
- In air	75	25
- In SF6 (Sulphur Hexafluoride)	90	40
- In oil	80	30
Silver coated or nickel coated (see note-4)		
- in air	105	55
- in SF6	105	55
- in oil	90	40
Tin coated (see note 4 & 5)		
- in air	90	40
- in SF6	90	40
- in oil	90	40
2. Connections, bolted or the equivalent (see note-6) Bare copper, bare copper alloy or Aluminum alloy	90	40

-in air -in SF6 -in oil Silver coated or nickel coated -in air -in SF6 -in oil Tin coated -in air -in SF6 -in oil	105 100 115 115 100 105 105 100	55 50. 65 65 50 55 55 50
3. All other contacts or connections made of bare metals or coated with other materials	See Note- 7	See Note- 7
4. Terminals for the connection to external conductors by screws or bolts(see note-8) -bare -silver, nickel or tin coated -other coatings	 90 105 See Note 7	 40 55 See Note 7
5. Oil for oil switching devices (See Notes 10 & 11)	90	40
6. Metal parts acting as springs	See Note 12	See Note 12
7.Material used as insulation and metal parts in contact with insulation of the following classes (See Note 9) -Y (for non-impregnated materials) - A (for materials immersed in oil or impregnated) -E -B -F -Enamel : oil base -synthetic in air -H	 90 100 120 130 155 100 120 180 See Note 13	 40 50 70 80 105 50 70 130 See Note 13

-C		
8. Any part of metal or insulating materials in contact with oil, except contacts.	100	50

NOTES :

1) According to its function, the same part may belong to several categories as listed in table. In this case the permissible maximum value of temperature and temperature rise to be considered are the lowest among the relevant categories.
2) Care shall be taken to ensure that no damage is caused to the surrounding Insulating material.
3) When contact parts have different coating, the permissible temperature and temperature rises shall be those of the part having the lower value permitted in table.
4) The quality of the coated contacts shall be such that a layer of coating material remains at the contact area :

   a) after making and breaking test (if any):
   b) after short time withstand current test:
   c) after the mechanical endurance test ;

   According to the relevant specification for each equipment. Otherwise, the contacts shall be regarded as "bare".
5) For fuse contacts, the temperature rise shall be in accordance with IEC publications on High Voltage Fuses.
6) When connection parts have different coatings, the permissible temperature rises shall be those of the parts having the higher value permitted in table.
7) When materials other than those given in table are used, their properties shall be considered, notably in order to determine the maximum permissible temperature rises.
8) The values of temperature and temperature rise are valid even if the conductor connected to the terminals is bare.
9) The following classification of insulating materials is in accordance with IEC - 85.

   Class-Y: Insulation consists of materials or combinations of materials such as cotton, silk and paper when suitably impregnated. Other materials may be included in this class if by experience or accepted tests they can be shown to be capable of operation at Class-Y temperature.

   Class - A: Insulation consists of materials or combinations of materials such as cotton, silk and paper when suitably impregnated or coated or when immersed in a dielectric liquid such as oil. Other materials or combination of materials may be included in this class if by experience or accepted tests they can be show to be capable of operation at Class - A temperatures.

   Class - E: Insulation consists of materials which by experience or accepted tests can be shown to be capable of operation at Class - E temperatures.

Class -B: Insulation consisting of materials or combinations of materials such as mica, glass fiber, asbestos, etc., with suitable bonding substances. Other materials or combinations of materials, not necessarily inorganic, may be included in this class if by experience or accepted tests they can be shown to be capable of operation at Class - B temperatures.

Class - F: Insulation consists of materials or combinations of materials such as mica, glass fiber, and asbestos with suitable bonding substances. Other materials or combinations of materials not necessarily inorganic may be included in this class if by experience or accepted tests they can be shown to be capable of operation at Class –Ftemperatures.

Class - H: Insulation consists of materials such as siliconed elastomer and combination of materials such as mica, glass fiber, asbestos etc., with suitable bonding substances such as appropriate silicone resin. Other materials or combination of materials may be included in this class if by experience or by accepted tests they can be shown to be capable of operation at Class - H temperatures.

Class - C: Insulation consists of materials or combination of materials such as mica, porcelain, glass and quartz with or without an inorganic binder. Other materials or combinations of materials may, be included in this class if by experience or accepted tests they can be shown to be capable of operation at temperatures above the Class-H limit. Specific materials or combinations of materials in this class will have a temperature limit, which is dependent upon their physical chemical and electrical properties.

10) At the upper portion of the oil.
11) Special consideration should be given when low flash point oil is used in regard to vaporization and oxidation.
12) The temperature shall not reach a value where elasticity of the material is impaired.
13) Limited only by requirement to any damage to surrounding parts.

5.12.0 OPERATING MECHANISM AND ASSOCIATED EQUIPMENTS

5.12.1 The circuit breaker shall be designed for electrical local as well as remote control. In addition there shall be provision for local mechanical control (emergency trip).

5.12.2 The operating mechanism shall be of spring charging type (both for closing and opening operation) or semi pneumatic operation type in which closing operation is of spring charging type and opening operation is by pneumatic type or pneumatic type for both opening & closing operations. The mechanism shall be adequately, designed for the specified tripping and re-closing duty. The entire operating mechanism control circuitry, individual breaker compressor unit, hydraulic pump, spring charging motor etc., as required, shall be housed in an outdoor type, steel enclosure. This enclosure shall conform to the degree of protection IP-55 of IS-2147 and shall be suitable for mounting on a separate concrete plinth.

5.12.3 All working parts in the mechanism shall be of corrosion resistant material. All bearings which require greasing shall be equipped with pressure grease fittings.

5.12.4 The design of the operating mechanism shall be such that it shall be practically maintenance free. The guaranteed number of years of maintenance free operation, the number of full load and full rated short circuit current breaking operations without requiring any maintenance or overhauling shall be clearly stated in the tender bid. As far as possible, the need for lubricating the operating mechanism shall be kept to the minimum and eliminated altogether, if possible.

5.12.5 The operating mechanism shall be anti-pumping and trip free, for all method of closing operations i.e., electrical, mechanical, pneumatic, semi-pneumatic type and hydraulic type. There shall be no rebounds in the mechanism and it shall not require any critical adjustments at site. Operation of the power operated closing device, when the circuit is already closed, shall not cause damage to the circuit breaker or endanger the operator. Provision shall be made for attaching an operation analyzer to facilitate testing of breaker at site.

5.12.6 a) A mechanical indicator shall be provided to show open and close position ofthe breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided in the central control cabinet.

b) All the control knobs, manual spring charge etc., shall be easily approachable on-ground level. The height of these locations should be not more than 2000 mm from ground level.

5.12.7 The supplier shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker.

The detailed drawing indicating all the individual parts of the breakers and control mechanism duly marking parts number shall be furnished.

5.12.8 SEMI - PNEUMATIC OPERATING MECHANISM:

Pneumatic type operating mechanism for tripping and spring charging type operating mechanism for closing.

A) Closing operation:

i. Closing operation is made by closing spring. When the closing signal energizes the closing coil, the trigger is released and the closing spring closes the breaker.

ii. The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current.

The mechanism shall be capable of performing 5CO operations.

iii. The spring charging motor shall not take more than 30secs for fully charging the closing springs and provision shall be made for automatic charging of the closing springs as soon as they are discharged in a closing operation. For this, the mechanism shall be such that the charging of the springs by the motor does not interfere with the operation of the breaker.

iv. The motor shall be adequately rated to carryout a minimum of 5 close and open operations continuously. Also provision shall be made to protect the motor against overloads.

v. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of the closing springs when the breaker is already in the closed position. Provision shall also be made to prevent a closing operation to be carried out with the spring partially charged.

vi. Facility shall be provided for manual charging of the closing springs.

B) Opening operation:

The opening operation is affected by compressed air. When the opening signal energizes the trip coil, the latch and cam are released. Control valve is opened, which allows the compressed air and pushes down the opening piston and effects opening of the circuit breaker. The opening piston is held against the spring force.

a) Circuit breakers with pneumatic operating mechanism shall be provided with individual compressed air system with an adequate compressor motor unit, rated to meet full requirements of the respective circuit breaker.

b) The ICU shall be complete with air piping and accessories, all stop valves, tees, pressure reducers, etc., required for normal operation of the breaker.

c) The compressed air mechanism shall be capable of operating the circuit breaker under all duty conditions with air pressure immediately before operation between 85% and 105% of rated supply pressure. The make / break time at this supply pressure shall not exceed the specified make/break time written any values of trip coil supply voltage as specified.

d) The semi - pneumatic operating mechanism shall consist of pilot or auxiliary and main valves for closing and opening operation of the circuit breaker. The pilot valves shall be suitable for operations either electrically by electrical solenoids or by local control push buttons. The accessories shall include an intake filter, stop valve, non-return valve, drain valve, breaker position indicator, auxiliary contacts, operation counter, space heater, a set of terminal blocks, etc.

e) The operating mechanism shall also include necessary monitoring and safety interlocks such as pressure gauges with electrical alarm contacts for low/ high pressure signals, pressure switches for low pressure lock-out for closing, opening and auto re-closing operations and a safety valve. Local manual control shall not be provided. The closing and auto re-closing

lock-out pressure shall be such that the breaker shall be able to open immediately after closing or re-closing operation as the case may be. Provision shall exist for both local and remote electrical operation of the breaker. The mechanism shall be provided with anti-pumping features.

f) The compressed air stored in the local air receiver shall, at least, be sufficient to carry out 5CO operations and the charging time to restore the pressure shall be sufficiently short to complete the rated operating sequence viz., O-0.3See.-CO-3min-CO.

g) Compressed Air system:

i) Compressed air piping shall be carried out in accordance with BS : 162.

ii) Compressor shall be oil less rotary type complete with drive motors.

iii) Compressor shall be provided with automatic adjustable un-loading device.

iv) Compressor shall be provided with automatic start/ stop control along with hour meter to check the running of the compressor. Supplementary manual control shall also be provided.

v). Compressor drive motor shall be 3 phase, full voltage direct-on-line starting, constant speed, squirrel cage induction type, rated for continuous operation in the specified climatic conditions. The motor shall be totally enclosed fan cooled type with-Class 'E' insulation. Maximum permissible temperature rise of motor shall not exceed 65 º C over an ambient temperature of 50º C measured by resistance.

h) Air receivers:

i) Air receivers of circuit breakers shall be capable of performing the operating duties as listed against clause 20 of IEC Publication 652271-100.

ii) Air receivers shall have a manhole with cover for inspection and cleaning.

iii) Connections for air inlet and outlet, drain and relief valves on receiver shall be flanged type.

iv) Pressure gauge & pressure switch connection shall be of the screw type.

v) Accessories supplied along with the air receiver shall include but not be limited to the following :

a. Suitable safety valve to relieve full compressor discharge, at a set pressure equal to 1.1 times the maximum operating pressure.

b. Blow off valve auto drain tap with isolating and by-pass valve.

c. Dial type pressure gauge with isolating and drain cock and test connection and fitting for mounting on the receiver.

d. Isolating and drain cocks for the pressure switches.

e. Black flange with bolts, gasket, etc., for the test connection.

vi) Air receivers shall be hydro-statically tested to a pressure of 1.5 times the design pressure.

vii) Air receiver shall be designed in accordance with the latest edition of the ASME code for pressure vessel-section VIII of BS : 5197. A corrosion allowance of 3.0mm shall be provided for shell and dished ends. Receivers shall be coated on the inside face with antirust medium.

i) Compressor control and compressed air piping :

i) Compressor control shall be of the automatic start stop type initiated by pressure switches.

ii) All control equipment shall be housed in a totally enclosed sheet steel cabinet. Pressure gauge and such other indicating devices shall also be mounted on the control cabinet.

iii) In all other respect control cabinets shall be in accordance with the specification for "Control Cabinet as per Clause No. 5.23.

iv) All compressed air piping shall be of adequate diameter, bright annealed, seamless phosphorous, De-oxidized, non-Arsenical copper alloy or stainless steel pipe (C-106 of BS 2871- 1957).

v) The flow capacity of all valves shall be at least 20% greater than the total compressor capacity.

vi) All joints and connections in the piping system shall be brazed or flared as necessary.

j) Quality of Air :

Compressed air used shall be dry and free of dust particles. Arrangement for conditioning compressed air shall be provided as an integral part of air compressor system. Air shall condense at working pressure at a temperature of minus 10 deg. C. Measures of achieving this shall be brought out clearly in the bid. All instruments required for checking the quality of air shall be furnished as special tools along with the breakers.

k) Operating mechanism Housing:

Operating mechanism of unit compressor and all accessories shall be enclosed in a weather proof cabinet of sheet steel construction, the thickness of which shall not be less than 3mm. Hinged doors giving access to the mechanism at the front and sides shall be provided.

Suitable space heaters shall be mounted in the housing to prevent condensation. Heaters shall be controlled by differential thermostat so that the cubicle temperature is always, maintained approximately 10 deg. C above the outside air temperature. On/Off switch and fuse shall be provided for the heaters. Heaters shall be suitable for 240 V AC single phase supply. The heater leads shall be covered with porcelain material up to sufficient length to avoid melting of insulation of the leads.

5.12.9 PNEUMATIC OPERATING MECHANISM

Pneumatic operating mechanism for both closing and opening of the breaker -operations affected by compressed air. Other details are similar to the clause Nos. 5.12.8 (B) (a) to (k) above.

NOTE: In addition to the above details the Clause No. 5.23 for specification for control cabinet is applicable wherever necessary.

5.12.10 SPRING OPERATING MECHANISM :

Spring charging type operating mechanism for both closing and tripping.

Closing and opening operation :

i) Closing operation is made by closing spring. When the closing signal energises the closing coil, the trigger is released and the closing spring closes the breaker.

ii) The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide required energy for the tripping mechanism.

iii) The spring charging motor shall not take more than 30 secs for fully charging the closing springs and provision shall be made for automatic charging of the closing springs as soon as they are discharged in a closing operation. For this, the mechanism shall be such that the charging of the springs by the motor does not interfere with the operation of the breaker.

iv) The motor shall be adequately rated to carryout a minimum of 5 close and open operations continuously. Also provision shall be made to protect the motor against overloads.

v) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of the closing springs when the breaker is already in the closed position. Provision shall also be made to prevent a closing operation to be carried out with the spring partially charged.

vi) Facility shall be provided for manual charging of the closing springs.

5.13.0 CONTROL CIRCUIT :

5.13.1 The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

The control circuit shall include the following features

i) Two electrically independent trip circuits including two trip coils for 66 kV breakers to operate the three poles simultaneously.

ii) The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provision shall be made for local electrical control. For this purpose a local / remote selector switch and close and trip push buttons shall be provided in the breaker central control cabinet. Remote located control switches and

indicating lamps shall be provided in the control panel by the purchaser.

iii) Conveniently located manual emergency trip.
iv) Anti-pumping feature.
v) Auxiliary switches as specified elsewhere.
vi) Independence of trip circuit from local remote selection.
vii) Alarms, indications, monitoring equipments and interlocks as specified elsewhere.
viii) Trip circuit supervision for pre-trip as well as post-trip.

5.13.2 Closing coil shall operate correctly at all values of D.C voltage between 85% and 110% of the rated control voltage and shunt trip coil shall operate correctly under all operating conditions of the circuit breaker, up to the rated breaking capacity of the circuit breaker and at all values of D.C. control voltage between 70-110% of rated voltage.

5.13.3 To safeguard against the failure of D.C. supply for control circuits, the capacitor tripping device shall be provided. In case of D.C. supply failure the capacitor shall automatically discharge its energy through the trip coil causing it to operate and trip, the breaker, except when the breaker is in lockout condition due to low SF6 gas pressure.

5.13.4 A separate cabinet shall be provided for housing operating mechanism and control circuitry. These control cabinets shall meet the requirements specified in clause No. 5.23.

5.13.5 The tenderer shall furnish along with the tender bid, detailed schematic drawings showing all types of control, protection, monitoring schemes to be employed by the tenderer. The successful tenderer shall be required to modify the schemes, if necessary, after discussions with the purchaser.

5.13.6 Auxiliary switches:

Each operating mechanism of the circuit breaker shall be provided with Cam / Snap type auxiliary switches with ten (10) normally open and ten (10) normally closed contacts (10NO+10NC) contacts for each breaker for 123KV, 72.5KV & 33KV rating, exclusively for the purchaser's use with continuous current rating of 16A DC. Breaking capacity of the contacts shall be minimum 5A with circuit time constant less than 20 milliseconds at the rated DC voltage. Normal position of auxiliary switches refers to contact position when circuit breaker is open. There shall be provision to add more auxiliary switches at a later date if required. Additional contacts required for pole discrepancy relay etc., should be provided separately. The make of auxiliary switches shall be preferably of Siemens, Crompton Greaves Limited, L&T and Alsthom make.

5.13.7 Alarms and Indications:

Potential free contacts shall be provided, duly wired up to the operating mechanism housing / control cabinet for the following alarms and indications to be provided by the purchaser **both** on his control panels and **SCADA**. To cater to this requirement, sufficient number of potential free contacts shall be provided.

a) Alarms :
   - i) General lockout for SF6 gas / air / oil / Nitrogen gas.
   - ii) Low pressure of SF6 gas / low oil level.
   - iii) Auxiliary AC / DC supply failure.
   - vi) Low operating air pressure.
   - vii) Low operating nitrogen / gas pressure.

b) Indication :
   - i) Breaker on / off
   - ii) Spring charged

c) Mechanical Indication:

The operating mechanism housing shall be provided with the following mechanical indication / counters

   - i) Breaker on / off.
   - ii) Operation counter to register the number of breaker operations.

5.13.8 INTERLOCKS:

It is proposed to electrically interlock the circuit breaker with Purchaser's air break isolating switches in the switchyard in accordance with switchyard safety interlocking scheme. The details of the scheme shall be furnished to the successful bidder. The requirement of auxiliary contacts to be provided in breaker operating mechanism for successful operation of the scheme has been specified in clause 5.13.6.

5.14.0 MOUNTING:

5.14.1 The design and supply of support structure, required for mounting the circuit breaker in Purchaser's switchyard, shall be in the bidder's scope. The bidder's scope shall also include foundation bolts, nuts, plain washers, spring washers etc., necessary for the support structure. The support structure can be lattice type or tubular type and shall be made out of hot dip galvanised steel. Wheel mounted type support shall not be accepted. The support structure shall be installed on a concrete plinth of 300mm height to be arranged by the Purchaser. The foundation plan for the breakers have been furnished in the bid document. The mounting structures are to be designed suitable to foundation plans furnished. The height of the support structure shall meet the following requirements.

i) Vertical clearance of lowest live part as specified in clause 5.21.4.

ii) Minimum height of 2200mm above the top of concrete plinth (This is a statutory regulation).

5.14.2 The circuit breaker shall be connected to adjacent equipment in the switchyard through ACSR conductor. The maximum unsupported length of conductor on both sides of the Circuit Breaker is 10mtrs.

5.14.3 The loading data to be considered by the bidder for design of support structure shall include the following:

i. Dead weight of the circuit breaker, structure, Bus bars.
ii. Operational steady state and impact loading.
iii. Wind load on a circuit breaker, structure, Bus bars.
iv. Short circuit forces.

The support structure shall be designed on the basis of applicable Indian / International standards and codes of practice.

5.14.4 The foundation drilling plan shall be exactly in line with the details given in annexure. This is intended to ensure voltage class wise common foundation for circuit breaker irrespective of its make.

5.15.0 FITTINGS AND ACCESSORIES:

5.15.1 Following is a partial list of some of the major fittings and accessories to be furnished by supplier in the central control cabinet. Number and exact location of these parts shall be indicated in the bid

a) Central control cabinet in accordance with clause No.5.23 complete with
   i) Cable glands.
   ii) Local / remote changeover switch
   iii) Operation counter
   iv) Pneumatic / pressure gauges.
   v) Control switches to cut off control power supply.
   vi) MCB’s / Fuses as required.
   vii) The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 24 terminals spare for BWSSB's use.
b) Anti - pumping relay or anti - pumping contactor.
c) Rating and diagram plate in accordance with IEC incorporating year of manufacture.

5.15.2 Additional fittings for pneumatic & semi - pneumatically operated circuit breaker:

a) Unit compressed air system in accordance with Clause No. 5.12.8 (g).
b) Breaker local air receivers.
c) Pressure gauge spring loaded safety valve, pressure switch with adjustable contacts and explosion vents.
d) Pressure switch to initiate an alarm if the pressure in the auxiliary reservoir remains below a preset level for longer than it is normally necessary to refill the reservoir.
e) Stop, non-return and other control valves, piping and all accessories up to breaker mechanism housing.

5.16.0 PAINTING:

5.16.1 All metal sheet surfaces exposed to atmosphere shall be given two primer coats of zinc phosphate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paints shall be gray shade No. 631 of IS-5. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

5.16.2 Paint inside the metallic housing shall be of anti-condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

5.16.3 All components shall be given adequate treatment of climate proofing as per IS : 3202 as to withstand corrosive and severe service condition.

5.17.0 GALVANISING:

All ferrous parts including nuts, bolts, plain and spring washers of size M10 and above, support channels, structures, etc., shall be hot dip galvanized to conform to latest version of IS : 2629 or any other equivalent authoritative standard. All other fixing nuts, bolts, washers of size below M10 shall be electro galvanized.

5.18.0 EARTHING:

The operating mechanism housing, dead tank, support structures etc., shall be provided with two separate earthing terminals for bolted connection to 50x8mm GI flat to be provided by the purchaser for connection to station earth mat. The connecting point shall be marked with "Earth" symbol No. 86 of IEC publication 117-1 Part - I

5.19.0 NAME AND RATING PLATE:

5.19.1 Circuit breaker and its operating device shall be provided with rating plate/s made out of Anodized Aluminum, marked with the following data. The data shall be either punched or engraved on the plate/s.

a) Manufacturer's name or trade mark by which he may be readily identified.

b) Serial number and type designation of CB operating mechanism.

c) Year of manufacture.

d) Rated Voltage.

e) Rated Lightning impulse withstand voltage.

f) Rated Normal current.

g) Rated short circuit breaking current.
h) Rated Duration of short circuit.
i) Mass of circuit breaker with support structure.
j) Rated Auxiliary D.C. supply voltage of closing and opening devices.
k) Rated pressure of compressed air/ gas.
l) Rated out of phase breaking current.
m) Rated A.C. supply voltage of auxiliary circuits.
n) Rated Insulation level.
o) Rated Frequency.
p) Rated line charging breaking current and cable charging breaking current for EHV CBs.
q) Purchase Order reference.
r) Rated Operating sequence.
s) Weight of SF6 gas per pole / breaker.

The ratings plates shall be installed in such positions that the same are clearly visible to a man standing on ground.

5.19.2 Schematic diagram plate indicating the control circuit scheme shall be provided. The diagram plate shall be of AnodisedAluminium plate and shall be installed in such a position that the same is clearly visible to a man standing on ground.

5.20.0 The coils of operating devices shall be marked clearly with the catalogue number / reference number as indicated in control wiring diagram.

5.21.0 TAKE OFF TERMINAL PADS:

5.21.1 Terminal pads shall be provided with silver plating of the least 25 microns thickness if these are made of metal other than Aluminum. No such plating shall be required if the terminal pad is made out of Aluminum. The pads shall be suitably designed to take the approximate terminal loads, specified below.

5.21.2 The breaker shall be designed to withstand the rated terminal load, wind load / Earth quake load and short circuit forces. The short circuit forces to be considered for the design shall be based on length of bus bars consisting of conductors and phase to phase spacing shown below.

Voltage	Jumper length in mtrs.	Size of ACSR conductor	Phase to phase spacing in mts.
			66 kV Stations
72.5 KV	Max. 10 M	Drake / Twin Drake	2.00

5.21.3 The current density adopted for the design of the terminal pad shall in no case exceed 1.6A/sq. mm for copper pad and 1.0A/sq. mm for pad made of other material.

5.21.4 The vertical clearance of lowest live part of the breaker (i.e., not the center of the terminal pad) from ground level (including concrete foundation plinth) shall be as given below. In no case the height less than that indicated will be accepted.

72.5 KV Breaker - 4250 mm for Rigid bus/4600mm for strung bus

5.22.0 TERMINAL CONNECTORS:

5.22.1 The terminal connectors required for connecting circuit breaker to other equipments for mounting on aforesaid terminal pad shall meet the following requirements.

a) Terminal connectors shall be manufactured and tested as per IS: 5561.
b) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
c) Pad part of a clamp shall not be less than 10mm thick
d) All ferrous parts shall be hot dip galvanized conforming to IS: 2633.
e) For bimetallic connectors, copper alloy liner of minimum thickness of 2mm shall be cast integral with Aluminum body. Current density adopted for design of pad shall be 1.6A / 1A per sq. mm for copper / Aluminum respectively.
f) Flexible connectors shall be made from tinned copper.
g) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
h) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS : 5561.
i) Terminal connectors shall be suitable for receiving ACSR conductors as detailed in Clause No. 5.21.2.

5.23.0 CONTROL CABINETS:

The Control cabinet shall conform to the following requirement.

a) Control cabinets shall be free standing floor mounting type.
b) Control cabinets shall be sheet steel enclosed and shall be dust, water and vermin proof. Control cabinets of the operating mechanism shall be made out of 4mm HR thick sheet steel or equivalent CR sheet steel or 10mm thick aluminum plate or casting. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Control cabinets shall be provided with double hinged door and padlocking arrangement. The door shall be provided with handle for opening / closing. The door hinges shall be of union joint type to facilitate easy removal and the distance between hinges shall not exceed

350mm. Door shall be properly braced to prevent wobbling. Sloping rain-hood shall be provided to cover all sides. 15mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP : 55 as per IS 2147.

c) Equipment and devices shall be suitable for operation on specified auxiliary AC / DC supply system.

d) Motors rated 1KW and above being controlled from the control cabinet would be suitable for operation on a 415V, 3 phase, 50Hz system. Fractional KW motors would be suitable for operation on a 240V, single phase, 50Hz AC supply system.

e) Push button shall be rated for not less than 16Amps, 415Volts AC or 5Amp, 230V / 110V DC with 2 NO + 2 NC contacts and shall be flush mounted on the cabinet door and provided with appropriate name plates.

f) For motors up to 5KW, contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the stalled current of the associated motor which shall be assumed equal to 6.5times the full load current of the motor at 0.2 p.f. For motors above 5KW, automatic star delta type starters shall be provided. 3 pole contactors shall be furnished for 3 phase motors and 2 pole contactors for single phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. Contactors shall be suitable for uninterrupted duty and shall be of duty category class AC4 as defined in IS : 2959. The main contacts of the contactors shall be silver-plated and the insulation class for the coils shall be class E or better.

The dropout Voltage of the contactors shall not exceed 70% of the rated voltage.

g) Contactor shall be provided with a three element, positive acting ambient temperature compensated, time lagged, hand reset type thermal over load relay with adjustable setting. Hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed.

h) Single phasing preventor relay shall be provided for 3 phase motor, to provide positive protection against single phasing.

i) Mini starters shall be provided with no volt coils when required.

j) Power cables will be of 1100 volt grade, standard copper conductor, PVC insulated, PVC sheathed single steel wire armoured and PVC jacketed. All necessary cable terminating accessories such as glands, crimp type tinned copper lugs etc. for power as well as control cables shall be included in bidder's scope of supply. Suitable brass cable glands shall be provided for cable entry.

k) Wiring for all control circuits shall be carried out with 1100 Volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than 2.5sq. mm. At least 10% spare terminal blocks for control wire terminations shall be provided on each panel. The terminal blocks shall be of non-disconnecting stud type. All terminals shall be provided with ferrules indelibly

marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity, which shall not be less than 10 Amps. Terminals for receiving purchaser's cables should be marked or numbered.

l) Control cabinet shall be provided with 240V, 1 phase, 50Hz, 20W fluorescent lighting fixture with On / Off switch and 240V, 1 phase, 15Amp, 3 pin socket for hand lamp, with electrical & mechanical cover with chain.

m) Suitable strip heaters shall be provided inside cabinet with thermostat to prevent moisture condensation. Heaters shall be controlled by suitable toggle switch of industrial quality.

n) All AC control equipment shall be suitable for operation on 240V, 1 phase, 2 wire, 50Hz system.

o) Items inside the cabinet made of organic material shall be coated with a fungus resistant varnish.

6.0.0 TESTS :

6.1.0 Type Tests :

6.1.1 The Circuit Breakers offered shall be fully type tested as per the relevant standards. The equipment offered if not type tested will be rejected. These tests must have been conducted not later than five years from the date of bid opening. In case the equipment of the type and design offered, has already been type tested, the tenderer shall furnish four sets of the type test reports along with the offer. In case these type tests are conducted later than five years, allthe type tests as per the relevant standards shall be carried out by the successful bidder in the presence of purchaser's representative at free of cost and no charges shall be paid by the BWSSB. The purchaser reserves the right to demand repetition of some or all the type tests in the presence of his representatives even though the type test reports are less than 5 years old on the day of bid opening. For this purpose, the bidder may quote unit rates for carrying out each type test in the relevant schedule. The prices quoted by the tenderer towards conductance of type tests and additional tests shall be taken into consideration for bid evaluation. For any change in the design / type already type tested and the design / type offered against this specification, the purchaser reserves the right to demand repetition of tests without any extra cost.

6.1.2 The following constitute the type tests :

1) Short circuit making and breaking tests including terminal fault tests, short line fault tests.
2) Capacitive current tests.
3) Small inductive current tests
4) Mechanical endurance tests.
5) Dry power frequency test.
6) Wet power frequency test.
7) Lightning impulse test,

8) Temperature rise test.

6.1.3 The following additional type tests are proposed to be conducted. The type test charges for these tests shall be quoted along with other type tests as per IEC -62271 -100 in the relevant schedule and the same shall be included in the total bid price.

i) Corona extinction voltage test
ii) Out of phase closing test as per IEC-60267 and IEC-62271
iii) Line charging breaking current test as per IEC -62271
iv) Cable charging breaking current as per IEC-62271
v) Seismic withstand test in un-pressurized condition

6.2.0 ACCEPTANCE AND ROUTINE TESTS:

6.2.1 All acceptance and routine tests as stipulated in IEC -62271 shall be carried out by the supplier in the presence of Purchaser's representative.

The following constitute routine tests:

a) Power frequency voltage withstand dry test on main circuit.
b) Voltage withstand tests on control & auxiliary circuits.
c) Measurement of resistance of main circuit.
d) Mechanical operating tests.
e) Design and visual checks.

6.2.2 In addition to the mechanical and electrical tests specified by IEC, the following shall also be performed.

Speed curves for each breaker shall be obtained with the help of a suitable operation analyzer to determine the breaker contact movement during opening, closing, auto re-closing and trip-free operation under normal as well as limiting operating conditions (control voltage pneumatic pressure etc.). The tests shall show the speed of contacts directly at various stages of operation, travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at break / make operation etc. This test shall also be performed at site for which the necessary operation analyzer along with necessary transducers, cables, console, etc., shall be furnished as mandatory maintenance equipment.

6.2.3 Immediately after finalization of the Programme of type/ acceptance / routine testing, the supplier shall give sufficient advance intimation to the purchaser to enable him to depute his representative for witnessing the tests.

6.3.0 ADDITIONAL TESTS

The purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier / laboratory or at any other recognized laboratory / research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this specification.

7.0.0 INSPECTION:

7.1.0 The inspection may be carried out by the Purchaser or his representative at any stage of manufacture. The successful tenderer shall grant free access to the purchaser's representative/s at a reasonable notice when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

7.2.0 The supplier shall keep the purchaser informed in advance, about the manufacturing Programme so that arrangement can be made for stage inspection.

7.3.0 The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. The supplier shall keep the purchaser informed in advance, about such testing programme.

7.4.0 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested unless the same is waived by the purchaser in writing.

8.0.0 QUALITY ASSURANCE PLAN :

8.1.0 The tenderer shall invariably furnish following information along with his offer, failing which his offer shall be liable for rejection. Information shall be separately given for individual type and voltage rating of circuit breaker :

i) Statement giving list of important raw materials, including but not limited to

a) Contact Material
b) Insulation
c) Porcelain
d) Oil
e) Sealing Material
f) Contactor, limit switches etc., in control cabinet.

Names of sub-suppliers for the raw materials, list of standards according to which the raw-materials are tested, list of test normally carried out on raw materials in presence of purchaser's/tenderer's representative, copies of test certificates.

ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.

iii) List of areas in manufacturing process, where stage inspections are normally carried out by the purchaser / tenderer for quality control and details of such tests and inspections.

iv) Special features provided in the equipment to make it maintenance free.

v) List of testing equipment available with the bidder for final testing of breakers vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. The limitations in testing facilities shall be very clearly brought out

in the relevant schedule i.e., schedule of deviations from specified test requirements.

8.2.0 The successful tenderer shall, within 30 days of placement of order, submit following information to the purchaser.

i) List of raw-materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

ii) Type test certificates of the raw-material and bought out accessories.

iii) Quality assurance plan (QAP) withhold points for purchaser's inspection. The quality assurance plan and purchaser hold points shall be discussed between the purchaser and supplier before the QAP is finalised.

8.3.0 The supplier shall submit the routine test certificate of bought out items and raw-material, at the time of routine testing of the fully assembled breaker.

9.0.0 DOCUMENTATION AND DRAWINGS :

9.1.0 Documentation:

All drawings shall conform to relevant international standard organization (ISO) specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in System International Units.

9.2.0 Drawings:

The Tenderer shall furnish four sets of relevant descriptive and illustrative published literature/pamphlets and the following drawings/documents for preliminary study.

a) General outline drawings showing outside dimensions, shipping dimensions, weights, quantity of insulating media, air receiver capacity and such other prominent details.
b) Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts, with lifting dimensions for maintenance.
c) Schematic diagrams of the scheme for control, supervision and re-closing.
d) Structural drawing, design calculations and loading data for support structures.
e) Foundation drilling plan and loading data for foundation design.
f) Type test reports of circuit breakers.
g) Test reports, literature and pamphlets of bought out items and raw materials.
h) Guarantied technical particulars of circuit breakers.

9.3.0 The supplier shall, within two weeks of placement of order, submit four sets of final versions of all the above said drawings/documents for purchaser's approval. The purchaser shall communicate his comments/approval on the drawings/documents to the supplier within reasonable period. The supplier shall, if necessary, modify the

drawings/documents and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of purchaser's comments. After receipt of purchaser's approval, the supplier shall, within three weeks, submit 20 prints duly laminated and two good quality reproducible of the approved drawings.

9.4.0 The supplier shall furnish twenty copies of bound manual covering erection, commissioning, operation and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices. Marked erection drawings shall identify the component parts of the equipment as shipped to enable Engineer/Purchaser to carryout erection with his own personnel. Each manual shall also contain one set of all the approved drawings, type test reports and as well as acceptance test reports to corresponding consignment dispatched.

9.6.0 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the supplier's risk.

9.7.0 Approval of drawings/documents/work by the purchaser shall not relieve the supplier of any of his responsibility and liability for ensuring correctness and correct interpretation of the drawings/documents for meeting the requirements of the latest revisions of applicable standards, rules and codes of practices.

10.0.0 TEST REPORTS:

i) Four copies of type test reports shall be furnished to the purchaser within one month of conducting the tests. One copy will be returned duly certified by the purchaser to the supplier within three weeks thereafter and on receipt of the same, supplier shall commence with the commercial production of the concerned material.

ii) Four copies of acceptance test reports shall be furnished the purchaser. One copy will be returned, duly certified by the purchaser and only there afterwards shall the material be dispatched.

iii) All works of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.

iv) All test reports of tests conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when requested for by the purchaser.

11.0.0 PACKING AND FORWARDING:

11.1.0 The equipment shall be packed in crates suitable for vertical/horizontal transport as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the

equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

11.2.0 Each consignment shall be accompanied by a detailed packing list containing the following information:

a. Name of the consignee.
b. Details of consignment.
c. Destination.
d. Total weight of consignment.
e. Sign showing upper/lower side of the crate.
f. Handling and unpacking instructions.
g. Bill of materials indicating contents of each package and spare materials.

The supplier shall ensure that the packing list and bill of materials are approved by the purchaser before dispatch.

12.0.0 RECOMENDED SPARES:

The tenderer shall furnish in his offer, a list of recommended spares with unit rates for each circuit breaker that may be necessary for satisfactory operation and maintenance of the circuit breaker for a period of 5 years. The Purchaser reserves the right of selection of items and quantities of these spares to be ordered. The cost of such spares shall not be considered for tender evaluation. The unit prices should be valid for two years from the date of issue of detail A/T.

SCHEDULE – B

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

	Bidder's Name	
	Circuit Breaker Rating	
1	General	
	a. Name of the Manufacturer	
	b. Country of Manufacture	
	c. Type of Circuit Breaker	
	d. Manufacturer's type designation	
	e. Standard Applicable	
	f. Rated Voltage (kV ms)	
	g. Rated Current :	

	i. Under normal condition (A)	
	ii. Under site conditions (A)	
	h. Rated frequency (Hz)	
	i. Number of poles	
	j. Whether 3 pole or single pole unit	
	k. Whether all the 3 poles ganged electrically or mechanically	
	l. Whether dead tank or live tank design	
	m. Type of installation	
	n. No. of break per pole	
	o. Latching Current (kA)	
2	Guaranteed Ratings	
	a. Rated short circuit breaking current	
	i. Symmetrical component at highest system voltage (kA)	
	ii. DC Component (%)	
	iii. Asymmetrical breaking current at highest system voltage (kA)	
	b. Rated Making Capacity	
	i. At higher rated voltage (kAp)	
	ii. At lower rated voltage (kAp)	
	c. i. Maximum Total break time under any duty condition for any current up to rated breaking current with limiting conditions of voltage and pressure (ms)	
	ii. Rated breaking time (ms)	
	d. Closing time (ms)	
	e. Minimum opening time under any condition with limiting voltage and pressure (ms)	
	f. Maximum opening time under any condition with limiting voltage and pressure (ms)	
	g. Maximum close open time under any condition with limiting voltage and pressure (ms)	
	h. First pole to clear rating	
	i. Short time current rating (kA) for 1 Sec.	
	j. Rated operating duty	
	k. Maximum breaking capacity under kilometric faults and rated TRV characteristic (kAp)	
	l. Maximum breaking capacity under phase opposition (kAp)	
	m. Maximum line charging breaking current with temporary over voltage up	

	to 1.4 p.u. (A)	
	n. Maximum over voltage (p.u.) on switching transformer on no load and corresponding charging current	
	o. Maximum period between closing of first contact & last contact in a pole (ms)	
	p. Maximum pole discrepancy (ms)	
	q. Maximum arc duration and corresponding current under lockout pressure.	
	r. Small fault current breaking capacity (kAp)	
	s. Pre-insertion resistor (if applicable)	
	i. Value / pole (Ohms) with tolerance	
	ii. Minimum and Maximum duration of insertion per pole (ms)	
	iii.Thermal rating for the c-1m-o-co-2m-c-1m-o-co for terminal fault considering maximum resistance and time setting.	
	iv. Thermal rating for the same duty as (iii) above for reclosing against trapped charges.	
	t. Maximum temperature rise for main contacts over design ambient temperature of 50°C	
	u. Rated voltage & pick up range for trip coil (V)	
	v. Rated voltage & pick up range for closing coil (V)	
	w. Rated pressure and limits of pressure of operating mechanism	
	x. Rated pressure and limits of pressure of extinguishing medium	
	y. Minimum dead time for	
	i. Three phase reclosing (ms)	
	ii. Single phase reclosing (ms)	
	z. Data of restriking voltage	
	i. Amplitude factor	
	ii. Phase factor	
	iii. Natural frequency	
	iv. Rate of rise of restriking voltage	
3	Dielectric withstand of complete breaker	
	a. One minute dry & wet power frequency withstand voltage	
	i. Between live terminal and ground (kV rms)	
	ii. Between terminals with breaker contacts open (kV ms)	

	b. 1.2/50 micro impulse withstand test voltage	
	i. Between live terminals and ground (kVp)	
	ii. Between terminals with breaker contacts open (kVp)	
	c. Corona extinction voltage (kV rms)	
	d. Maximum radio interference voltage (micro V) at 1.1 Ur/v3	
	e. Total creepage distance	
	i. To ground (mm)	
	ii. Between terminals (mm)	
4	Operating Mechanism	
	a. Type of operating mechanism for	
	i. Closing	
	ii. Opening	
	b. Manufacturer's type designation	
	c. Normal power consumption (W) at rated voltage	
	i. Trip coil	
	ii. Closing coil	
4.1	Pneumatic operating mechanism	
	a. Rated operating pressure (kg/sq.cm)	
	b. Range of pressure for (kg/sq.cm)	
	i. Closing	
	ii. Opening	
	c. Air Consumption at rated pressure for	
	i. Closing (m3)	
	ii. Opening (m3)	
	iii. Close-open (m3)	
	d. Pressure drop/meter length of piping	
	e. Number and Capacity (m3) of breaker local air storage receivers	
	f. No. of close operations for which sufficient air is available in local receiver	
	g. Capacity of compressor (m3/hr) and working pressure (kg/cm2)	
	h. Maximum time for which compressor can operate continuously (min)	
	i. Time to fill	
	i. Air receiver after one CO operation (min)	
	ii. For making up of losses occurring in hours (min)	

	j. Pressure at which compressor	
	i. Starts (kg/cm2)	
	ii. Stops (kg/cm2)	
	k. Material of compressed air piping	
	l. Inner & outer dia. of main piping (mm)	
	m. Whether interpole piping included in scope of supply	
	n. Manufacturer's name for	
	i. Compressor	
	ii. Air receiver	
	iii. Pressure reducer	
	iv. Stop valves	
	v. Drain valves	
	o. Safety valve	
	i. Low pressure stage blow off at (kg/cm2)	
	ii. Intermediate stage blow off at (kg/cm2)	
	iii. High pressure stage blow off at (kg/cm2)	
	p. Safety valve opens at (kg/cm2)	
	q. No.of stored CO operation in breaker air receiver	
	r. Alarm switch closes on air receiver at (kg/cm2)	
	s. Lockout pressure (kg/cm2)	
	i. Closing	
	ii. Opening	
	iii. Auto reclose	
4.2	Hydraulic operating mechanism	
	a. Rated pressure of oil in operating cylinder (Kg/cm2)	
	b. Limits for pressure (Kg/cm2)	
	c. Quantity of oil (liter)	
	d. Details of arrangements to prevent change of position of breaker in the event of loss of hydraulic pressure.	
	e. Details of monitoring arrangement for hydraulic pressure.	
	f. No. of close -open operations possible after loss of AC supply to drive motor.	
	g. Details of hand pump set provided for emergency operation.	
	h. Pressure drop starting from lowest pressure at which motor starts for	
	i. C – operation	

	ii. O - operation	
	iii. CO - operation	
	iv. O - CO - operation	
	v. 2 - CO - operation	
	i. Time required to make up pressure upto loss of nitrogen pressure after	
	i. C – operation	
	ii. O - operation	
	iii. CO - operation	
	iv. O - CO - operation	
	v. 2 - CO - operation	
4.3	Spring charged mechanism	
	a. Number of close open operations possible after failure of AC supply to motor.	
	b. Time required for motor to charge the closing spring (min).	
	c. Whether indication of spring charged condition provided in central control cabinet.	
5	**Type of Breakers**	
5.1	SF6 Circuit Breakers :	
	a. Quantity of SF6 per pole (m3) at rated pressure.	
	b. Guaranteed maximum leakage rate per year.	
	c. Rated pressure of SF6 in operating chamber (kg/cm2).	
	d. Limits of pressure at which breaker operate correctly (kg/cm2)	
	e. Standard to which SF6 gas complies.	
	f. Whether 20% spare SF6 gas. Stored in unused gas cylinders, included in proposal.	
	g. Capacity & filling ratio of containers in which SF6 gas would be shipped (m3) and the corresponding pressure (kg/cm2)	
	h. Whether breakers are dispatched filled with SF6 or required to be filled at site.	
	i. Type and make of SF6 pipe coupling used.	
	j. Type and make of mandatory maintenance equipment.	
	i. SF6 gas filling and evacuation trolley (portable)	
	ii. SF6 gas drying, filling, evacuating	

	equipment and its capacity.	
	iii. Operating analyzer Type and make	
	iv. SF6 gas leak detector	
	k. Parameters of SF6 gas for initial filling and satisfactory operation.	
	i. Density	
	ii. Dielectric strength kV/mm	
	iii. Acidity (ppm)	
	iv. Water content (ppm)	
	v. Oil content (ppm)	
	vi. Condensation temperature (°C)	
	vii. Resistivity (Ohm-cm)	
	l. Whether details of SF6 gas viz test methods, handling etc. enclosed.	
	m. Type and material of gasket used to ensure gas tight joints for	
	i. Metal to metal joints	
	ii. Metal to porcelain joints	
	n. Method of housing SF6 gas compressors and equipment	
	i. At Circuit Breaker	
	ii. In control cubicle	
	o. Type and make of	
	i. Density meter	
	ii. Pressure gauge	
	p. Density meter Settings	
	i. Lockout	
	ii. Alarm	
	q. Minimum time interval between each make/break operation (ms)	
5.2	General	
	a. Whether OGA drawing enclosed	
	b. Weight of complete 3 phase breaker for foundation design (kg)	
	c. Weight of heaviest part of breaker (kg)	
	d. Impact loading for foundation design	
	e. Seismic level for which breaker is designed	
	f. Minimum safety clearance from earthed objects	
	g. Noise level in (dB) at base of the breaker	
	h. Minimum clearance in air	
	i. Between live parts (mm)	
	ii. Live parts to earth (mm)	

	iii. Live parts to ground level (mm)	
6	Constructional Details	
	a. Whether arcing contacts provided	
	b. Type and material of main contacts and arcing contacts	
	c. Contact pressure on main contacts (kg/cm2)	
	d. Contact separation in arcing position (mm)	
	e. Contact separation in open position (mm)	
	i. Main contacts	
	ii. PIR contacts	
	f. Whether pressure relief device for each of the gas chamber of SF6 CB provided	
	g. Rate of contact travel.	
	i. Opening (m/sec)	
	ii. Closing (m/sec)	
	h. Whether the making & breaking contacts are hermetically sealed	
	i. Type and capacity of device used to obtain uniform voltage distribution between breaks	
	j. Over voltage withstand capability of grading components (kV rms)	
	i. Continuous	
	ii. 10 Minutes	
	iii. 1 Minute	
	iv. 5 seconds	
	k. Number of auxiliary contacts per pole provided for BWSSB's use	
	l. Rated voltage of auxiliary contacts (V)	
	m. Current rating of auxiliary contacts	
	i. Continuous (A)	
	ii. DC breaking with 20 ms time constant (A)	
	n. Whether auxiliary contacts silver plated	
	o. Whether support structure included in supply	
	p. Height of support structure	
	q. Material of support structure	
	r. Standard to which the design of support structure conform	
	s. Whether foundation bolts for breakers and cabinets included in scope	

	of supply	
7	Detailed Literature	
	a. Whether the following are enclosed.	
	i. Type test reports as per IEC-56	
	ii. Factory test report and/or field test report incase of reactor switching duty	
	iii. Details of operating mechanism	
	iv. Drawing of breaker of support structure.	
	v. Calculations for compressed air plant sizing	
	vi. Details of SF6 gas filling, evacuating and testing plant	
	vii. Details of SF6 gas leak detector	
	viii. Precautions in use of SF6 gas	
	ix. Leaflets & literature bringing out salient features of equipment offered.	
	x. Schematic diagrams of switching mechanism for closing resistor showing the duration of insertion along with calculation for thermal rating of closing resistors.	
	xi. Whether drawings showing contacts in close, arc initiation, full arcing, arc extinction and open position enclosed	
	xii. Method of checking of Voltage distribution devices at site enclosed	
	xiii. Details along with a complete catalogue of operation analyzer enclosed	
	xiv. Data on capabilities of circuit breaker in terms of time and number of operations at duties ranging from 100% fault currents to load currents of the lowest possible value without requiring any maintenance or checks.	
	xv. Effects of non-simultaneity between contacts within a pole or between poles and also show how it is covered in the guaranteed rated break time	
	xvi. Details and type of filters used in interruptor assembly and also the operating experience with such filters	
	xvii. Curves supported by test data indicating the opening time under close open operation with combined variation of trip coil voltage and pneumatic/hydraulic pressure.	
	xviii. All duty requirements specified	

	along with adequate test reports.	
	CIRCUIT BREAKER - CONTROL CABINETS:	
1	Manufacturer's Name	
2	Indoor/Outdoor application	
3	Design ambient air temperature (^{o}C)	
4	Standards applicable	
5	Thickness of sheet steel (mm) and whether cold rolled or hot rolled	
6	Degree of protection provided	
7	Bill of material for all the equipment mounted on control cabinet giving the following details:	
	a. Make and type	
	b. Applicable Standard	
	c. Voltage rating	
	d. Current rating	
	e. Duty class. If applicable	
	f. Manufacturer's catalogue No.	
	g. Total heat load of cabinet (for purpose of ventilation requirement)	
8	Colour of finish paint IS : 5	
	a. Outside	
	b. Inside	
9	Control Wiring	
	a. Size of conductor	
	i. For CT circuits	
	ii. For other circuits	
	b. Conductor Solid/Stranded	
	c. Number of Strands/conductor	
10	Terminal Blocks	
	a. Make & type	
	b. Current rating	
	i. Power terminals (A)	
	ii. Other terminals (A)	
11	Space Heater Rating at 240 V AC	
12	Control cabinet drawing showing the following:	
	a. Outline dimensions, floor opening, floor/ wall/ pedestal fixing arrangements, weights etc.	
	b. Front view, inside view showing the mounting arrangement of various equipment.	
13	Schematic/wiring diagram of control cabinet enclosed	

14	Interconnection drawing showing cable, connections to the control cabinet enclosed	
15	Type test report to verify degree of protection enclosed	
16	Details of terminal rows:	
	i. Whether arranged vertical or horizontal	
	ii. Clearance from adjacent components.	
	iii. Distance between rows.	
	iv. Whether transparent protection cover provided.	
	CIRCUIT BREAKERS - TERMINAL CLAMPS AND CONNECTORS	
1	Manufacturer's Name	
2	Applicable Standards	
3	Type	
4	Material of connector	
	a. Clamp body	
	b. Bolts & Nuts	
	c. Spring Washers	
5	Rated Current	
6	a. Rated terminal load (kg)	
	b. Factory of Safety	
7	Minimum thickness of any part (mm)	
8	Weight of clamp complete with hardware (kg)	
9	Type test reports as per IS enclosed	
10	OGA drawing enclosed.	
	CIRCUIT BREAKERS - BUSHING/SUPPORT INSULATOR :	
1	Manufacturer's Name	
2	Type	
3	Applicable Standards	
4	i. Height	
	ii. Diameter (Top)	
	iii. Diameter (Bottom)	
5	Total creepage distance (mm)	
6	Rated voltage (kV)	
7	Power frequency withstand voltage for 1 minute (kVrms) dry and wet	
8	1.2/50 micro sec. impulse withstand voltage (kVp)	
9	250/2500 micro sec. switching impulse withstand voltage (kV p) dry and wet	

10	Corona Extinction voltage (k V)	
11	Weight (kg)	
12	Maximum allowable span (mm)	
13	Cantilever Strength (kg)	
14	OGA drawing enclosed.	
	Motors	
1	Manufacturer's Name & address	
2	Equipment driven by motor	
3	Motor type	
4	Country of origin	
5	Frame size	
6	Type of duty	
7	Type of enclosure and method of cooling	
8	Applicable standard to which motor generally conforms	
9	Type of mounting	
10	Direction of rotation as viewed from non-driving end	
11	Standard continuous rating at 40 deg. C ambient temperature as per Indian Standard (KW)	
12	Derated rating for specified Normal condition ie., 50 deg. C ambient temperature (KW)	
13	Rated Voltage (V)	
14	Rated speed at rated voltage and frequency(rpm)	
15	Full load current at rated voltage and frequency (A)	
16	Power factor at rated load	
17	Efficiency of motor at rated voltage and frequency (without any tolerance) at	
i.	Density duty point(%)	
ii.	100% of full load (%)	
18	Starting current (Amps) at	
i.	100% Voltage	
ii.	85% Voltage	
19	Torques at	
	a) Starting (Kg-Metre)	
	b) Pull up (Kg-Metre)	
	c) Pull Out(Kg-Metre)	
20	Stator winding Insulation	
	i) Class & type	
	ii) Tropicalised	
	iii) Temperature rise over specified ambient of 50 deg. C (deg. C)	

	iv) Method of temperature measurement	
21	Stator winding connector	
22	Number of star terminals brought out	
23	Type of terminal box for stator leads	
24	Bearing type	
	i. Driving End	
	ii. Non Driving End	
25	Type of Construction of Rotor	
26	Weight of Motor	
	i. Stator (Kg.)	
	ii. Rotor (Kg.)	
	iii. Total Weight (Kg.)	
27	Type Test Report Enclosed	

SECTION – 4(B) LIGHTNING ARRESTORS

TECHNICAL SPECIFICATION LIGHTNING ARRESTORS

Clause No. Particulars

1.0 General

2.0 Duty requirements

3.0 Constructional features

4.0 Fittings and Accessories

5.0 Tests

6.0 Spare parts

7.0 Parameters

8.0 Testing and Commissioning

LIGHTNING ARRESTERS

1.0 GENERAL

1.1 Qualifying Requirements please refer Vol- I Section IFB.

1.2 The surge arresters shall conform to IEC:60099 except to the extent modified in the specification and shall also be in accordance with requirements under section 1 and 2.

1.3 Arresters shall be of hermetically sealed units, self-supporting construction, suitable for mounting on tubular / lattice type support structures to be supplied by the Contractor.

2.0 DUTY REQUIREMENTS:

a. The surge arresters shall be of heavy - duty station class and gapless type (i.e., metal oxide type) without any series or shunt gaps.

b. The surge arresters shall be capable of discharging over voltages occurring during switching of unloaded transformers and long lines.

c. Void.

d. 60kV and 9kV class arresters shall be capable of discharging energy equivalent to class 2 of IEC for 72.5kV and 12kV system for two successive operations.

e. The surge arresters shall be suitable for withstanding forces as defined section - 2.

f. The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

g. The surge arresters are being provided to protect the following equipment whose insulation level are indicated in the table give below:

Equipment to be protected	Lightning impulse (KVp) for 72.5 KV system
Power transformer	±325
Instrument Transformer	±325
CB/Isolator phase to ground	±325
Across open contacts	-----

h. The duty cycle of CB proposed to the installed in 72.5KV System is 0-0.3Sec. – CO - 3Min - CO. The surge arrester shall be suitable for such circuit breaker duties in the arrester shall be suitable for such circuit breaker duties in the system.

3.0 CONSTRUCTIONAL FEATURES:

The feature and constructional details of surge arresters shall be in accordance with requirement stipulated hereunder:

a) The non - linear blocks shall be of sintered metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties event after repeated operations.

b) The surge arresters shall be fitted with pressure relief devices suitable for preventing shattering of porcelain housing and providing path for flow of rated faults cur-rents in the event of an-ester failure. Details shall be furnished in the bids along with quality checks.

c) The arresters shall not fail due to arrester, porcelain contamination.

d) Seals shall be provided in such a way that these am always effectively maintained even when discharging grated lightning current.

e) Outer insulator shall be porcelain conforming to requirements stipulated in Section - 2 (GTR). Terminal connectors shall conform to requirements stipulated under section - 2 (GTR).

Porcelain housing shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage up to the maximum design value for arrester.

f) The end fittings shall be made of nonmagnetic and corrosion proof material and preferably, be nonmagnetic.

g) The nameplate shall conform to the requirements of IEC incorporating the year of manufacture.

h) The heat treatment cycle details along with necessary, quality checks used for individual blocks along with insulation layer formed across each block are to be furnished. Metalizing coating thickness for reduced resistance between adjacent discs is to be furnished with additional information schedule of bid proposal sheets along with procedure for checking the same. Details of thermal stability test for uniform distribution of current on individual disc is to be furnished.

i) The manufacturer will submit data for rejection rate of ZnO blocks during manufacturing/ operation for the past three years.

4.0 FITTINGS AND ACCESSORIES:

a) 60 KV / 9 kV arresters shall be complete with insulating base having provision for bolting to flat surface of structure.

b) Self-contained discharge counters, suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit along with necessary connection. Suitable leakage current meters should also be supplied within the same enclosure. The reading of milli-ammeter and counters shall be visible through an inspection glass panel. The terminals shall be robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The design of the surge monitor shall be such that it is possible to tilt the surge monitor downwards by an angle of up to 45º from Horizontal plane.

c) Surge monitor consisting of Discharge counters and milli-ammeters should be suitable to be mounted on support structure of the arrester and should be tested for IP : 55 degree of protection. The standard supporting structure for surge arrester should be provided with a standard mounting pad, for fixing the surge monitor. The surge monitor should be suitable for mounting on this standard mounting pad. Also all nuts, bolts, washers etc., required for fixing the surge monitor shall have to be supplied by the Contractor.

d) Grading / Corona rings shall be provided on each complete an-ester unit as required. Suitable terminal connectors shall be supplied by the contractor.

5.0 TESTS:

5.1 **Type tests :** Type tested equipments shall be offered. The type test reports shall not be older than five (5) years on the day of bid opening. The type tests are to be conducted again without any extra cost to the BWSSB in case the type test reports are older than five (5) years on the day of bid opening. The type test charges are to be indicated in the schedule. The BWSSB reserves right to insist for conducting all or a few type tests even though the type tests are less than five (5) years old on the day, of bid opening, the payment in such cases will be made as per the rates in the schedule.

In accordance with the requirements stipulated under section 1 & 2 the surge an-esters should have been type tested as pr IEC / IS . They shall also be subjected to routine and acceptance tests in accordance with IEC document. In the switching surge operating duty test, the samples shall be pre heated to 70º C (instead of 60º C as given in IEC) prior to application of long duration surges for contamination test procedures outlined in ANSI - 062 - 11 - 1987 may be followed until IEC brings out alternate test procedure for the same.

The contractor shall submit type test procedures along with the bid each metal oxide block of surge arresters shall be tested for the guaranteed specific energy capability- in addition to the routine acceptance test as per IEC - 60099.

5.2 a) Acceptance Tests:

1. Measurement of power frequency reference voltage of the arrester units.
2. Lightning Impulse residual voltage on arrester units (IEC clause 6.3.2).
3. Internal lonisation or partial Discharge test.

b) Special Acceptance Test;

1. Thermal stability test on three sections (IEC 7.2.2)
2. Aging & Energy capability test on blocks (Procedure to be mutually agreed)
3. Watt-loss test

c) Routine tests :

1. Measurement of Reference voltage
2. Residual voltage test of arrester unit.
3. Internal Ionization test or partial discharge test.
4. Sealing test.
5. Verticality checks on completely assembled surge arresters as a sample test on each lot.

d) Test on surge monitors ;

The surge monitors shall also be connected in series with the test specimens during residual voltage and current impulse withstand tests to verify efficacy of the same. Additional routine / functional tests with one 100 A and 10 KA current impulse, (8 / 20 micro sec.) shall also be performed on the surge monitor.

e) Test on insulators :

All routine tests shall be conducted on the hollow column insulators as per IEC - 60233.

6.0 **SPARE PARTS:**

Bidder shall include in his proposal spare parts as mentioned in Sections - 1 & 2.

7.0 PARAMETERS :

A. SURGE ARRESTER:

a)	Rated arrester voltage KV	60	9
b)	Nominal discharge		

	Current of 8 / 20 micro sec wave 10 KA		10KA	
c)	Minimum discharge capacity		5kJ / KV (referred to rated arrester Voltage corresponding to minimum Discharge Characteristics	
d)	Continuous operating voltage at 50 deg C KV		50	7.5
e)	Max. switching surge residual voltage (1 KA) kVp		175	---
f)	Max. residual voltage kVp at			
	i) 5 KA		560 kVp	
	ii)10 KA nominal discharge current (kVp)		600	195
g)	Max. steep current impulse residual voltage at l0 kA		650 kVp	
h)	Long duration discharge class		2	2
i)	High current short duration test value (4/ 10 micro		100	-----
	second wave)		kAp	----
j)	Current for pressure relief test KA RMS		31.5	------
k)	Low current long duration test value (2000 micro sec)	---------	As per IEC	
l)	Pressure relief class	----------		
A----------				
m)	Installation	Outdoor		Outdoorr
n)	Class	Station		Station
o)	Minimum creepage distance for arrestor housing (mm)	1815		300
p)	Terminal Connector Suitable for ACSR	Drake		Coyote /Rabbit

Conductor Size

q) Take Off ----------Vertical or Horizontal ----------

r) Connection ----------Phase to Earth----------

Note :- In isolated OR unearthed Neutral system, the voltage rating of the S.A. should be 110% of the nominal voltage in the case of capacitor bank.

8.0 TESTING AND COMMISSIONING:

An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the Field Quality Program / Instruction of the equipment supplier or BWSSB without any extra cost to the BWSSB. The contractor shall arrange all instruments required for conducting these tests along, with calibration certificates and shall furnish the list of instruments to the BWSSB for approval.

a) Leakage current measurement

b) Resistance of ground connection.

SECTION – 4(C) ISOLATORS

TECHNICAL SPECIFICATION :ISOLATORS

CLAUSE NO	**PARTICUALRS**
PART-I	
1.0	SCOPE
2.0	LOCATION
3.0	SERVICE CONDITION
4.0	GOVERING SPECIFICAION
5.0	RATING AND OTHER PARTICULARS
PART –II	
1.0	TYPE OF DISCONNECTS.
2.0	CURRENT DENSITY.
3.0	DESIGN AND CONSTRUCTION.
PART-III	
1.0	TESTS.
2.0	INSPECTION
3.0	DOCUMENTATION.
4.0	PACKING AND FORWARDING.

SECTION 4 (C) (ISOLATORS)

SECTION – i : TECHNICAL SPECIFICATION FOR 60kV AIR BREAK ISOLATORS

PART I

1.00 SCOPE

1.01 This specification covers design, manufacture, testing and supply of following voltage and current class of isolators.

a) Void.

b) Manually operated: 66KV, 1250Amp

The type of mounting and the provision of earth switch shall be as follows

a) Upright mounting type with manually operated earth switch

b) Upright mounting type without earth switch.

c) Under hung mounting type without earth switch.

1.02 The isolator shall be of the manual operated type with and without earthing switches and shall complete with all parts and accessories including insulator operating rods, mounting attachments, necessary for their efficient operation.

1.03 The earthing blades shall be of the manually operated type are shall be complete with all parts and accessories including mounting attachment, operating rod, operating mechanism box etc., necessary for the efficient operation.

1.04 It is not the intent to specify completely herein. All details of the design and construction of equipments, however the equipment shall confirm in all respect to high standards of engineering mentioned in clause No. 4.0 design and workmanship and shall capable of performing in continuous commercial operation up to the suppliers guarantee in. a manner acceptable to the purchaser, who will interpret the meanings of drawing and specification and shall have the powers to reject any work or material which, in his judgment, is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation along with associated equipments, interlock, protection schemes, etc. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifica.11N, brought out in this specification and / or the commercial order or not. All similar parts particularly removable ones shall be interchangeable.

1.05 The isolator shall be suitable for Local manual control.

2.00 LOCATION

2.1 The isolators are required at sub stations specified above, where the operating conditions i.e., height of live point and phase to phase dimensions, will vary quite considerably from location to location.

3.00 SERVICE CONDITIONS:

3.01 The 110KV / 66 KV triple pole air break isolators are intended to be used primarily with associated circuit breakers for sectionalizing lines, and transformers

3.02 The earthing blades are intended to be provided on the line/Capacitor sectionalizing isolators for solidly ear-thing, each of the phase conductor of the line before any repair / maintenance work on the transmission line is undertaken.

3.03 ATMOSPHERIC CONDITIONS

Please refer to meteorological data Annexure - II, Volume - II.

4.0 GOVERNING SPECIFICATION:

4.1 The isolator shall unless otherwise specified, generally conform the IS : 9921 (Part I to IV) - 1985, which shall be applied in the manner altered, amended or supplemented by this specification, the latest Indian Electricity Rules wherever applicable.

4.02 Any deviation from this specification offered to improvement performance, utility and efficiency of equipment proposed by the bidder will be given due consideration, provided full particular with justification thereof are furnished.

4.03 In the preparation of this specification, details have been taken from IEC 600 - 129 "alternating current disconnects (Isolators) and earthing switches", and IS 9921 (Part-I to IV) "Specification for alternating current disconnects (isolators) and earthing switches for voltages above 1000V ”.

4.04 Equipment meeting with the stipulations of equivalent IEC, ANSI, CSA, DIN standards which ensure equal or better quality than the standards listed in Clause No. 4.05, shall also be acceptable. In such case the bidder should submit along with this offer, two copies of such standards, in authentic English translation, if the language of the standard is other than English. In case of dispute, the stipulations in English translation, submitted by the bidder shall prevail. Further, in the event of conflict between the stipulations of the standard adopted be the bidder, corresponding Indian Standard specification shall prevail.

4.05 In this specification reference has been made to the following Indian standard and other specifications.

i)	IS : 9921-85 Part-I, II, III & IV)		Specification for alternating current Disconnects (isolators) and ear thing switches for voltages above 1000V.
ii)	a) IS: 2544-1973 & b) IS : 5350-1970	-	Porcelain post insulators for systems with nominal voltage greater than 1000V.
iii)	IS : 7608	-	Phosphor bronze wires (for general engineering purposes)
iv)	IS : 2108-1977	-	Black hard malleable iron castings
v)	IS : 1570 (Part - IQ- 1979	-	Carbon steel (unalloyed steels)
vi)	IS : 2071 (Part-I &ll)-1974	-	General definitions, test requirements & test procedures.
vii)	IEC: 600129 (isolators) and	-	Alternating current disconnects earthing switches
viii)	IS : 7906 (Part-Ill)-1975	-	Helical compression springs
ix)	IS: 5561 – 1970	-	Electric power connectors
x)	IS: 996-1979 electric	-	Single phase small AC and Universal motors.
xi)	IS: 5358-1969	-	Galvanizing of ferrous parts.
xii)	IS : 2633 zinc	-	Method of testing conformity of coating of coated articles.

5.00 RATING AND OTHER PARTICULARS

5.01 The isolators shall be designed for the following rating and other particulars.

SI.N	Particulars	66KV

o.		
i	Type	.....manually operated
		Double break, upright mounting/ with the movement of the blade in a horizontal plane suitable for outdoor installation
ii	No. of poles (Phases)	Three
iii	Rated Voltage	72.5KV
iv	Rated normal current	2000/1250A
v	Rated frequency	50 Hz
vi	System neutral earthing	.. effectively earthed...
vii	Rated short time withstand current of **main switch** and **earth switch**	31.5KA (rms) for 3 secs
viii	Rated peak withstand current	2.5 times the rated short time withstand current
ix	Rated 1.2/50 micro second impulse withstand voltage (peak) a) to earth b) across isolating distance	 325kv 375kv
xi	Operating time of the isolator	--shall not exceed 10 seconds--
xiii	Temperature rise a. Copper contacts in air i. Silver faced Copper ii. Bare copper b. Terminal of isolator to be connected to external conductors by bolts i. Silver faced copper ii. Bare copper c. Metal parts acting as springs	Max. Temp deg.C 105 75 105 90 The temperature shall not exceed a value, where the elasticity of the materials is impaired. For pure copper the temp. limit is 75deg. C
xiii	Safe duration of over load a. 150 % of rated current b. 120% of rated current	 5 minutes 30 minutes
xiv	Minimum creepage distance (mm)	1815
xv	Rated mechanical terminal load a. Straight load (Kgf) b. Across load (Kgf)	 40.76 13.26
xvi	Phase to Phase spacing for installation(mm)	2000
xvii	Height of center line of terminal pad above ground level (mm)	4250

5.02 The isolator will be called upon to close or interrupt the charging current drawn by bus bars, breakers and similar equipments. The bus selectors and by pass isolators will be used to change over the line connection from main bus bar to duplicate bus bar without the interruption of power supply, in the event of outage of line circuit breakers. Hence isolators should be capable of closing or interrupting a current of magnitude indicated in 5.01 (iv) above.

5.03 RATING AND OTHER PARTICULARS FOR EARTHINS SWITCHES:

5.03.01 The earthing blades shall be designed for the following rating and other particulars.

i.	Type	Manually operated, vertically mounted, vertical air break type, suitable for outdoor installation.
ii.	Rated Voltage	Associated with respective 72.5KV rated voltage isolators.
iii.	Rated frequency	50 Hz.
iv.	No. of poles(phases)	three
v.	Rated short time withstand current	31.5KA (rms) for 3 secs for 72.5 KV systems
vi.	Rated peak withstand current	2.5 times the rated short time withstand current.

5.03.02 Isolators provided with ear thing blades shall have a set of contacts so as to effectively earth the fixed contact of the isolator, when the ear thing blade is closed. The earth blade and its contacts shall be capable of carrying the same rated peak short circuit current and the rated short time current as applicable to the main isolator. The earth switch fixed contact shall be identical to that of main isolator fixed contact. The moving contacts shall also be made of electrolytic copper. The ear thing of the blades shall be effected by flexible copper blades, liberally rated to carry the full short circuit current specified in clause 5.01 (vii – viii)

5.03.03 The earthing blades of all poles of the isolator shall be mounted on the same shaft and shall be operated by a single and common operating handle which shall be distinct from the one for the main switch of the isolator. The blades of all poles shall fasten simultaneously into all fixed contacts.

5.04 **CLEARANCE**:

5.04.01 The clearance between live parts and ground structure shall not be less than those specified in the IS – 10118, part – III, 1982. The length of break in full open position should be such that there is absolutely, no possibility of arc over from the live parts to the de-energized parts on which any maintenance work have to be done. The speed of opening or closing the switch shall be designed to ensure that the arcing during the operation is reduced to the minimum.

Part - II
ISOLATORS
GENERAL TECHNICAL REQUIREMENTS

1.00 TYPE OF ISOLATORS :

The ISOLATORS shall be of three phase gang operated horizontal, double break type with turn and twist type moving blades and with or without gang operated vertical break earth blades as per requirements.

2.00 CURRENT DENSITY:

Current density, to be adopted, for all parts of isolator and terminal connector shall not exceed the following limits.

a) Hollow tube sections – Copper - 2.0 A / Sq. mm

b) Other sections and terminal connectors
Copper - 1.6 A/Sq. mm
Aluminium - 1.0 A/Sq. mm

3.0 DESIGN AND CONSTRUCTION :

3.01 Qualifying Requirements : Please refer Vol – I, Section IFB

The full particulars of design, manufacture, template and quality control devices developed for manufacture of the equipments - offered in respect of the following items shall be furnished with drawings and descriptions.

i. Contacts, material, current density etc.,
ii. Design of contact pressure.
iii. Contacts support and fixing arrangement on insulators
iv. Turn and twist mechanism, clamps, locks, etc.
v. Bearings, housing of bearing, bushes, etc.
vi. Balancing of heights.
vii. Coupling pipes, joints, connection adjustments.
viii Base plates.
ix. Down pipe, guides joints.
x. Brass bushes and bearings at various joints
xi. Operating mechanism, type of gear, auxiliary switch, size and thickness of box, degree of protection. Gland plate, gland, etc.
xii. Nuts, bolts and fasteners
xiii. Interlocking devices

Offers without the above information or with incomplete information is **liable for rejection.**

3.02 TYPE AND CONSTRUCTION:

The design of the isolators shall be such that the switch can be changed to right or left hand control without excessive labour and with a minimum change of parts. The live parts shall be of non-rusting, non-corroding metal. Current carrying parts shall be nonferrous. Bolts, screws and pins shall be provided with lock washers, keys or other equipment locking facilities. Current carrying parts shall be made of copper alloy or equivalent material. The switch shall not require lubrication of any part, at frequent intervals.

The isolator shall be suitable for mounting in upright or under hung position (with the blades moving in horizontal plane) on steel / fabricated steel structures. The heights at which the isolators will be mounted along with phase to phase dimensions are as per clause 5.00, Part - I. Any change in dimensions, will be intimated to successful bidder. Necessary lengths of operating rod as required shall be supplied. The bidder should agree to modify the base mounting detail of under hung switches depending upon the supporting beam mounting details, if so required, by the purchaser at a later date.

3.03 OPERATING MECHANISM:

3.03.01 Void.

3.03.02 FOR MANUALLY OPERATED ISOLATOR:

a). Manual operating mechanism, gang operated through crank & reduction gear shall be provided for main switch.

b) Manual operating mechanism, gang operated through a lever / handle for the operating shaft shall be provided for earth switch.

3.03.03 The design of the operating mechanism shall. be Such that minimum energy is required for operation and one person shall be able to operate the switch without undue effort. The blades shall be in positive continuous control throughout tile entire cycle of operation. Suitable reduction gear to achieve above aspects may be provided, for main switch and shall close or open with about 20 revolutions of the crank. The earth switch shall close or open by rotation of lever / handle through 90 degrees.

The operating pipes and rods shall be sufficiently rigid to maintain positive control without tension or compression & there shall also be capable of withstanding all torsional and bending stresses due to operation of the disconnecting switch. It shall not be possible, after final adjustment has been made for any part of the mechanism to be displaced at any point in the travel sufficiently to allow improper functioning of the switch, when the switch is opened or closed at any speed. All holes, ill crank, linkages, etc., having

moving pins, shall be drilled to accurate fit, so as to maintain the minimum amount of slack and lost motion. The operating mechanism and its controls shall be so designed that under no circumstances the switch blades travel is interrupted before it reaches the fully close or open position. The operating mechanism shall be suitable to hold the main switch or earth switch in closed or opened position to prevent operation by gravity, wind, short circuit, seismic acceleration, vibration, shock, accidental touching etc.

3.03.04 CONTROL CABINET:

The operating mechanism mid all accessories shall be enclosed in a weather, dust and vermin proof cabinet. The control cabinet of each operating mechanism shall be made out of 12 SWG (2.64 mm thick) steel sheet. or 10mm thick aluminum in the form plate or casting. Control cabinet shall be provided with hinged doors along with padlocking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type gasket shall be provided to ensure degree of protection at least IP 55 as per IS : 2147.

The motor operating mechanism / manually operating mechanism shall be mounted on the base supporting structures or on a separate Support- structure at a height of 300 mm from the ground level. Operating or lever for manual operation shall be at a convenient height of 1000 mm above ground level for easy operation. The unsupported length of the operating rod shall not. exceed 3 meters. Guide bearings shall be provided at suitable intervals. All brackets angles or other members mid accessories necessary for fixing the operating mechanism to switch supporting structure. and the bearing for operating rods shall be supplied. Rust proof pins and bearings of the bronze bushing, ball or roller type shall be provided. All ball and roller bearings shall be protected from weather by means of covers and grease retainers. Bearing pressures shall be kept low to ensure long life.

3.03.05 GEAR:

The disconnect may be required to operate occasionally with considerably long idle intervals. Special care shall be taken for selection of material for gear and lubrication of gears to meet these requirements. The gears shall be made of bronze or any other better material and lubricated for life with graphite or better quality non-draining or non-hardening grease. complete details of components, materials, self-lubricating arrangement, grade of lubricant, details of jigs, fixtures and devices used for quality check shall be furnished in the bid.

3.03.06 GLAND PLATE AND GLANDS:

Removable gland plate with double compression type brass type glands shall be provided with each operating mechanism for terminating of cables. Exact quantity of glands to be provided, shall be intimated to the successful bidder.

3.3.7 AUXILIARY SWITCHES:

Each disconnect switch shall be provided with EIGHT normally closed electrically separated spare contacts, in addition to the auxiliary contact required for its operation and indication mounted in

a weather proof, dust tight metal housing suitable for outdoor use and with necessary cable glands. Auxiliary switch shall be provided for the grounding blades also. The auxiliary contacts, shall be made of non-ferrous metal. The contact shall be convertible type so that normally open contact May be converted to normally closed contact and vice versa. The auxiliary contact shall be rated at 10 Amps. at 240 V AC and 2 Amps. at 110V DC.

The auxiliary contact shall be adjustable type to suite the following requirements ;

a) Signaling of "Closed position" shall not take place unless the main contacts have reached a position so that rated normal and short time current can be carried safely.

b) Signaling of "open position" shall not. take place unless the main power contacts are at a safe isolating distance.

c) All earthing blade assemblies shall be provided with three sets of normally open and three sets of normally closed auxiliary switches for signaling to the control room and for interlocking with any other equipment.

d) The auxiliary switches and auxiliary circuit shall be capable of carrying a current of atleast 10 Amps continuously.

e) Auxiliary switches shall be capable of breaking atleast 2 A in a 110V DC circuit with a time constant of not less than 20 milli seconds.

f) Quick make and break (QMB) type auxiliary, switches shall have sharp action built in within this switch.

g) The auxiliary switches shall be actuated by a cam or similar arrangement directly mounted on the isolator shaft without any intermediate levers, linkages, etc., to ensure foolproof operation.

3.03.08 WIRING AND TERMINAL BLOCK:

All wiring inside the operating mechanism cabinet shall be done with 1100V grade PVC insulated 2.5 sq. mm stranded copper cable as per IS : 1554 Part I Latest version. All wiring shall be provided with suitable identifying PVC or other plastic ferrules at the end. All the terminal marking shall be indelible preferably engraved. Separate terminal blocks of stud type for AC or DC wiring shall be provided in the cabinet. The ends of wires shall be provided with tinned terminal spade crimped on to the wires. The wiring connected with the heaters in the panel shall be provided with porcelain beaded insulator for a short distance from the heater terminal. No joints shall be permitted in the wiring. All spare contacts of relays, push button, auxiliary

switches etc., shall be wired up to the terminal blocks in the mechanism box.

The fuses provided with motor and heater circuit shall be cartridge type (HRC) with suitable fittings.

The terminal block should be located to allow easy access. Terminal blocks shall be 1100 Volts grade, clip-on type, 10 mm square or approved equivalent type and shall have 20% spare terminals. Insulating barriers shall be provided between adjacent connections.

All relays, contactors and other electrical devices mounted in the panel shall have name plates with a rating data and manufacturer's name, etc., Suitable identification label shall also be provided for control switches and fuses etc., including position indications of isolator / earth switch**.**

3.03.09 LOCKING / INTERLOCKING:

The operating mechanism of the isolator shall be provided with means for being locked with padlocks effectively either in the closed or in the open position.

The isolators shall be provided with a suitable electrical interlock arrangement to work in conjunction with associated circuit breakers. The arrangement shall be such as to prevent operation of the isolator either manually or on motor operation when the circuit breaker is in the closed position. The electrical inter locking shall be suitable for 110V DC supply available at site.

The operation of isolator shall be possible only by means of only one device at a time, i.e., either manually or on motor operation. Adequate means shall, however be provided to make manual operation of isolator possible in the event of failure of auxiliary DC supply to isolator operating mechanism. Under such contingencies also, the isolator operation shall be duly interlocked with the circuit breaker so that the manual operation by means of the operating handle is possible only when the circuit breaker is in the open position. The isolator mechanism box shall consist of solenoid operating device, which shall prevent insertion of manual opening handle, when the associated circuit breaker is closed, by energizing the solenoid through the circuit breaker auxiliary circuit.

The isolator shall be suitable for provision of castles mechanical locks / interlocks for which drawings shall be supplied by the purchaser after placement of orders.

The interlock shall be provided along with each earth blade assembly such that operation of earth blade assembly is possible only when the associated isolators are locked in the open position by integral lock.

The design of the earthing blade assembly shall be such as to permit use of a pad lock, for locking the operating handle of the earthing blade assembly in the open or in the closed position.

3.04 CONSTRUCTIONAL FEATURES:

3.04.01 FIXED AND MOVING CONTACTS:

The isolator shall have heavy-duty self-aligning high pressure - contacts of modem design. The contact shall be made of high grade, high conductivity, and heat resisting material. The main contacts shall be made of hard drawn electrolytic copper and the surface shall be silver plated. Arcing contacts wherever provided shall close first and open last.

The isolators blades / arms shall be made preferably from tubular section of hard drawn electrolytic copper having suitable diameter and shell thickness, and the contact surface shall be heavily silver plated.

The surface of the contacts shall be liberally designed to withstand safely the-highest short circuit current of the system as specified in the clause 05.01 (vii) - (viii) of part - I.

The male and female contact assembly and blades shall ensure

i) Electro dynamic withstand ability during short circuit without any risk of repulsion of contacts.
ii) Thermal with stand ability during short circuits.
iii) Constant contact pressure even when the live parts of the insulators stacks are subjected to tensile stresses the insulators stacks are subjected to tensile stresses due to linear expansion of connected bus - bars, flexible conductors either because of temperature variation or strong winds.
iv) Self - wiping action during closing and opening (preferably twisting type contacts). The surface shall be wiped during closing and opening operation to remove any film, oxide coating, etc. wiping action shall not cause scouring or abrasion of surfaces.
v) Self - wiping ensuring smooth closing of the switch. The temperature rise of the contacts and other current carrying parts shall not be more than 45 deg. C over an ambient air temperature of 45 deg. C, while carrying the rated current continuously. The temperature rise due to passage of rated short-circuit current for a period of 3 seconds shall not cause an), annealing or welding of contacts.

Fixed guides shall be provided so that proper seating of contacts will be obtained by closing even when a blade is out of alignment by 2.5 min or less.

All movable pars which may be in the current path shall be shunted by flexible copper conductors to prevent breaking due to repeated bending.

Fabrication shall be made with suitable jig to avoid deviation during production. Details of size and shape of contact, springs, back plate, fixing arrangements, design of contact pressure, life of contacts, limit of temperature rise etc., shall be furnished along with the tender.

3.04.02 MOUNTING OF CONTACTS:

Fixed contacts shall be mounted on a block or channel welded to 10 mm thick M.S. plate with holes for fixing on insulators. Slots shall be provided for marginal adjustment of height of contacts. The contacts shall rest on a brass block and with initial tension. Suitable device shall be provided to prevent dashing. Fabrication, welding etc. shall be done in suitable jig to avoid deviation during production.

3.04.03 TURN AND TWIST MECHANISM:

Turn and twist mechanism shall be provided with adequate locking to avoid opening or loosening by wind, short circuit force etc., on moving blade. The springs shall be made out of stainless steel or phosphor bronze or any other better material to have adequate strength and resilience and shall be encased with grease to avoid exposure to rain. The clamps and plates be made out of at least 10 mm thick M.S. plate or flat. Fasteners with nylock nuts shall be used wherever necessary. Vulnerable parts shall be fabricated by tubular gas cutting and milling. The entire- mechanism shall be fabricated in suitable jig and template to avoid deviations during production.

3.04.04 All lives parts shall be designed to have smooth surfaces without any sharp points, edges and other corona producing surfaces so as to eliminate corona. at specified extinction voltage or at **1.1 x rated voltage**, if extinction voltage is not specified.

3.04.05 FASTNERS:

Nuts, bolts and washers of M -16 and higher size shall be hot-dip galvanized. The bolts used on tapped holes of insulators cap shall be galvanized by centrifuge process to avoid excess deposition of zinc on threads. Nuts, bolts and washers of less than M -16 size shall be of stainless steel when used on live parts and nickel plated brass in other parts.

3.04.06 **BEARINGS**

The design and construction of the various bearings should embody all the features required to withstand the climatic conditions specified to ensure dependable and effective operation, even after long period

of in action. All bearings in the current path except those specially designed as high pressure contact should be shunted by flexible copper housing having adequate cross section.

Rotating insulator shall be mounted on a housing with bearings. The housing shall be made of gravity die cast metal with smooth surfaces and suitably machined for seating the bearings. Two nos. of bearings with adequate shaft diameter and distance between the bearings shall be provided to avoid wobbling during operations. The bearings shall be of at least 75 mm internal diameter. The bearings shall be of reputed make and lubricated for life. All other friction locations shall be provided with suitable bearings or stainless or brass bushes. The bearings, bushes, joints, springs, etc., shall be so designed that no lubrication shall be required during the service. Complete details of bearings, bushes housing greasing, etc., shall be furnished with tender.

3.04.07 BALANCING OF HEIGHT:

Fixed insulators shall be provided with elevator base plate with four studs for balancing of height for isolator of rated voltage of 72.5 KV and above. Thickness of plate and diameter of stud shall be at least 10 mm and 25 mm, respectively. Adequate numbers of nuts, lock nuts and washers shall be provided. Taper washer shall be provided to match inclined surface of steel sections.

3.04.08 TANDEM AND DOWN PIPE:

The operating down pipe and tandem pipe shall be of heavy duty GI pipe of the following sixes (Bore dia) for different KV class

		66KV Isolators
a)	Bore dia of tandem pipe	32mm
b)	Bore dia of down operating pipe	50mm

Further outside diameter and thickness of pipe shall be as follows as per table - 3 of IS : 1239 (Part - 1) 1990. Mild steel tubes. - Heavy.

S1. No.	Nominal Bore in mm	outer dia Minimum(mm)
1.	32	42
2.	40	47.9
3.	50	59.7

i. Tandem pipe:

Two Nos. of tandem pipe shall be used for phase coupling of double break isolator. Base plate of insulators for connection of tandem pipe shall be made out of one piece of at least 10 mm. thick MS plate. Bolt and shackle device shall be used to connect tandem pipe to the base plate. Wherever unavoidable, sliding clamps may be used. These clamps shall be made out of at least 10 mm thick MS plate with four(4) nos. of nuts and bolts. A grub screw shall be provided for securing connection of tandem pipes.

ii) The pipe shall be terminated into a suitable swivel or universal type joint between the insulator bottom bearing and the operating mechanism to take cares of marginal angular misalignment at site. All brackets, guides, etc., shall be mounted on the base of the isolator. Arrangement of mounting any guide, bracket, mechanism and the base shall not be accepted, for upright mounting type isolator.

3.04.09 BASE :

Each pole of the isolator shall be provided with hot dip galvanized rolled steel base provided with holes for mounting bolts and designed for mounting on a steel structure. The bases shall be rigid and self-supporting and shall require the guying or cross bracing between phases other than the supporting structure. The composite frame of the base shall be made of channel of following minimum sizes.

100 x 50 x 6 / 8 mm for 66KV isolators
(twin channel)

Fabrication, welding etc. shall be done by suitable jig, power press, and templates to avoid deviations during production. Details and dimensions of sections, jig, templates and device used for production of the base shall be furnished with tender. The necessary galvanized bolts and nuts for fixing the bases to the structure shall be in scope of supply.

3.05 EARTHING SWITCH:

One earthing switch per pole forming an integral part of the line disconnecting switch and manually operated shall be supplied wherever called for in the schedule of requirements. The earthing switch shall match with main switch. The earthing switch shall be designed for the rating as indicated in 5.03.01 of Part - I. A suitable flexible braided connector shall be provided on the hinge end of the earthing blade for connection to ground bus. The earthing blade shall be operated by a separate mechanism, but shall be mechanically inter looked with the disconnecting switch so that the grounding blade can be closed only when the disconnecting switch is open and vice versa.

If possible similar interlock shall be provided with the bypass isolator. Alternatively electrical interlock between the grounding switch and by pass isolator shall be offered.

3.06 INSULATORS:

3.06.01 The isolator shall be provided with solid core insulators.

a) These shall be of single unit to be used for 66kV systems. The dimensions and other parameters unless otherwise specified shall generally conform to IS - 5350-Part-11 & IEC60273.

b) The cylindrical type post insulators shall be of solid core type. Insulators of similar type shall be interchangeable. The mechanical strength class for outdoor cylindrical post insulators shall be of strength class 6, corresponding mechanical strength in tension, compression and torsional shall be as per IS : 5350 Part - II. When operated at maximum system voltage, there shall be no electrical discharge. Shielding rings, if necessary shall be provided.

c) The parameters of the insulators required shall conform to IS : 0350 - Part - II - 1973 or IEC60 273.

The dimensions, pitch circle diameter, no. of bolts, size of bolt holes, etc., shall conform to the parameters detailed in IS : 5350 Part - II 1973 or IEC 273.

In the case of 66kV system the cylindrical post insulator shall consist of single unit only.

d) The insulator shall be provided with a completely galvanized steel base designed for mounting on the support. The base and mounting arrangement shall be such that the insulator shall be rigid and self-supporting and no guying or cross bracing between phase shall be necessary.

3.06.02 The price of the isolators shall include the cost of insulators which shall be quoted separately. The porcelain used for the manufacture of the insulators shall be homogenous, free from laminations and other flaws or imperfections that might effect the mechanical or dielectric. quality and shall be thorough vitrified, tough and impervious to moisture. The glazing of the porcelain shall be uniform brown colour, with a smooth surface arranged to shade away rain water and free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.

The porcelain and metal parts shall be assembled in such a manner and with such materials that any differential thermal expansion between the metal and porcelain parts throughout the operating temperature range will not loosen the parts or electrical strength or

rigidity. The assembly shall not have excessive concentration of electrical stress in any section or across leakage surfaces. The cement used shall not give rise to chemical reaction. with metal fittings. The insulator shall be suitable for water washing by rains or artificial means in service conditions. Further the insulators to be supplied shall be of high- quality and should not result in mismatch and misalignment of stacks during erection and operation.

Each cap shall be of a high grade cast iron or malleable steel casting or steel forging. Cap and base insulators shall be interchangeable with each other. The insulator shall conform to the requirement of the latest edition of IS : 2544, or any other equivalent standard. The bidder should furnish the characteristics of insulators.

3.06.03 All the ferrous metal part shall be hot dip galvanized smoothly as per IS : 3638 (as amended up to date), IS : 2623 or any other equivalent authoritative standard. The material shall be galvanized only after shop operations upon it have been completed. The metal parts be for galvanization should be thoroughly cleaned of any paint, grease, rust, scales or alkalies or any foreign deposit which are likely to come in the way of galvanization process. The metal parts coating shall withstand minimum four one minute dips in copper sulphate solution as per IEC - 168.

The insulator unit shall be assembled in a suitable jig to ensure correct positioning of the top and bottom metal fittings relative to one another. The phases of the metal fitting shall be parallel and at right angle to the axis of the insulator and corresponding holes in the top and bottom metal fittings shall be in a vertical plane containing the axis of the insulator.

It shall be sole responsibility of the supplier to carry out thorough inspection and quality, checks on the insulators at the insulator supplier works before offering the insulators for purchaser's inspection.

3.07 ACCESSORIES:

The accessories to be provided on the insulator shall include but not to be limited to the following:

3.07.01 **Position Indicators :**

A position indicator to show whether the isolator is in ON or OFF position.

3.07.02 **Counter Balance Springs**

Counter balance springs, cushions, etc., shall be provided to prevent impact at the end of travel both on opening and closing of isolator. The springs shall be made of durable and non-rusting type alloy.

3.07.03 NAME PLATE:

Isolators, earthing switches and their operating devices shall be provided with their nameplate. The nameplate shall be weather proof and corrosion proof. It shall be mounted in such a position that it shall be visible in the position of normal service and installation. It shall carry the following information.

a) ISOLATORS:

- Bangalore Water Supply and Sewerage Board& P.O. No.
- Name of Manufacturer.
- Designation type
- Serial number
- Rated voltage
- Impulse withstand voltage to earth.
- Rated current.
- Rated short time current.
- Rated maximum duration of short time current.
- Rated short time current peak.
- Rated mechanical terminal load.
- Weight.

b) EARTHING SWITCH

- Bangalore Water Supply and Sewerage Board& P.O. No.
- Name of Manufacturer.
- Designation type
- Serial number
- Rated voltage
- Rated short time current.
- Rated maximum duration of short time current.

- Rated mechanical terminal load.
- Weight.

c) OPERATING DEVICE

- Bangalore Water Supply and Sewerage Board& P.O. No.
- Name of Manufacturer.
- Designation type
- Rated voltage
- Rating
- Weight.
- Reduction gear ratio
- Auxiliary, contacts quantity and rating.

3.07.04 PADLOCKING DEVICE:

The isolator and earthing switch shall be provided with padlocking device to permit locking of the isolator and earthing switch in both fully open and fully closed positions.

3.08 AUXILIARY POWER SUPLY

3.08.01 Auxiliary electrical equipment. shall be suitable for operation Oil the following supply systems.

a)	Power devices	415V, 3 Phase, 4xvirc 5OHz neutral grounded AC system with variation of -30 to –100%
b)	AC control & protective devices lighting fixture, space heaters Fractional. horse power motors	240 V single phase 2 wire 5OHz AC supply with one point grounded.
c)	DC alarm control & protective devices from station batteries of	110V, 2 wire ungrounded DC supply with variation of -20 to + 10%

3.08.02 Above supply voltage may vary as follows:

a)	AC supply	Voltage variation : + 10% to -30% Frequency variation: (+) or (-) 5% Both variation may occur simultaneously Or independently,
b)	DC Supply	(-) 20% to (+) 10%

Each of the foregoing supplies shall be made available at one terminal point for each isolator for operation of accessory and auxiliary equipment. Terminal point is the control cabinet of the isolator. Bidders' scope shall include distribution beyond the point of supply.

3.09 SIGNALING

3.09.01 Signaling of the close position shall not take place unless the movable contact has set in a position in which the rated normal current, the peak- withstand current and the short time withstand current can be carried safely.

3.09.02 Signaling of open position shall not take place unless the movable contact has reached the position such that the clearance between the contacts is at least 80% of the isolating distance.

3.10 EARTHING:

3.10.01 Flexible copper connections shall be provided between rotating earth blades and the frame, which shall have a cross section of at least 50 mm square and shall be tinned or suitably treated against corrosion.

3.10.02 The frame of each disconnect and earthing switch shall be provided with two reliable earthing terminals for connection to the purchaser's earthing conductor / flat so also clamping screw suitable for carrying specified short time current. Flexible ground connectors shall be provided for connecting operating handle. to the earthing flat. The diameter of clamping screw shall be at least 12 mm. The connecting point shall be marked with earth symbol.

3.11 TERMINAL CONNECTORS

The disconnecting switches shall be provided with high conductivity bimetallic terminal connectors and suitable for Aluminum pipes (BS 1600 schedule 40) and Drake ACSR conductors, the size of which will be indicated. to successful bidder. The connector shall be rigid in respect of ACSR conductors. The terminal connectors shall be expansion type in respect of Aluminum pipes. The terminal connector shall conform to IS : 5561 1970.

Further the terminal connectors shall be suitable for both horizontal or vertical take off.

For bimetallic type of connectors, necessary steps shall be taken by the manufacturers to ensure that there is no adverse effect on the connector and the connected equipment due to bimetallic action.

3.12 SUPPORTING STRUCTURE:

3.12.01 The bidder shall quote unit prices per Metric Tonne for support structure for the isolators offered. These galvanized support structures shall be fabricated as per the drawings enclosed for the respective class of isolators. The weight of the supporting structure indicated in the drawing is a provisional weight. The bidder shall quote unit price per metric tonne.

3.12.02 The masonry or concrete in foundations shall be arranged and constructed by the Contractor.

3.13 ASSEMBLY

The disconnect shall be fully assembled at the works of the bidder. Typical operation shall be carried out on each type of fully assembled disconnect to ascertain that all parts fit correctly and function satisfactorily.

3.14 PAINTING, GALVANIZING AND CLIMATE PROOFING:

3.14.01 All interiors and exteriors of enclosures, cabinets mid other metal parts shall be thoroughly cleaned to remove all rust scales, corrosions, grease and other adhering foreign matter and surfaces treated by recognized phosphating (Eg. Seven tank phosphating sequence), After such preparation of surfaces two coats of zinc oxide primer shall be given by suitable stoving and air-drying, etc., before final paint.

Colour of the final paint shall be of shade No. 631 of IS-5, i.e., epoxy light grey. The final painted cubicle shall. present aesthetically pleasing appearance free from any dent of uneven surface

3.14.02 Paint inside the metallic housing shall be of anti - condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

3.14.03 All ferrous parts not suitable for painting such as structural steel, pipes, rods, levers, linkages, nuts a-lid bolts used in other than current path etc., and also supporting structures shall be hot dip galvanized. Galvanization shall be done after completion of fabrication which shall be capable to prevent corrosion in view of the severe climatic conditions.

Thickness of zinc coating shall not be less than 610 gm of zinc per sq. meter of surface. Zinc coating shall be smooth clean and of uniform thickness and free from defect. Preparation of galvanizing and the galvanizing itself shall not adversely effect the mechanical properties of the coated material, The quality shall be established by tests per IS : 2633. Galvanizing of nuts and bolts shall be carried out by centrifugal or suitable process so that the bolts will easily fit into the tapped holes / nuts.

3.14.04 All components shall be given adequate treatment of climate proofing as per IS : 3202 so as to withstand corrosion and severe conditions.

3.14.05 Complete details of painting, galvanizing and climate proofing of the equipments shall be furnished in the tender.

PART - III

1.00 TESTS :

1.01 Type tests :

1.01.01 The equipment offered, shall be fully type tested. The type test reports shall not be older than 5 years on the day of bid opening. The type tests are to be conducted again if the reports are older than 5 years on the day of bid opening at no extra cost to BWSSB. The bidder shall quote for all type tests individually in schedules. The BWSSB reserves the right to demand repetition of some of all the type tests even though the test reports are less than 5 years old on the day of bid opening. In such cases the payment will be made as per rates quoted in the schedule. Please refer to Clause 13 Inspection Testing and Inspection Certificate., General technical Requirements, Volume - II.

1.01.02 During the type test the disconnect shall be mounted on its own support structure or equivalent support structure and installed with its own operating mechanism to make the type test representative. Drawing of equivalent support structure if any and mounting arrangement made for type tests shall be furnished for purchaser's approval before conducting the type tests.

1.01.03 The type tests shall be conducted on the disconnect along with approved insulators and terminal connectors.

1.01.04 Mechanical endurance test shall be conducted On the main switch as well as earth switch on one disconnect of each type

1.01.05 LIST OF TYPE TESTS:

List of type tests to be carried out as per IS : 9921 Part - VI 1985, are as given below.

a) ISOLATORS:

i) Visual examination of components,
ii) Dimensional verification of parts.
iii) Assembly, interchangeability and verification of critical dimensions.
iv) Measurement of resistance of main circuit and earth circuit (before and after mechanical endurance test)
v) Temperature rise test (before and after mechanical endurance test)
vi) Mechanical endurance test.
vii) Short time withstand current and peak withstand current tests.
viii) One minute power frequency voltage wet withstand tests across the isolating distances and to earth.
ix). Standard lightning impulse voltage withstand tests on auxiliary and control circuits and auxiliary switches.

x). One minute power frequency withstand voltage test on auxiliary and control circuits and auxiliary switch.

xi) Verification of operation during application of rated mechanical terminal loads.

xii) Galvanization tests.

xiii) Chemical composition of contact material, springs and fasteners and bushes.

xiv) Physical tests on springs and fasteners and copper strip / tubes.

b) EARTHING SWITCHES:

i). Visual examination of components.

ii). Dimensional verification of components.

iii). Assembly, interchangeability and verification of critical dimensions.

iv) Measurement of resistance of earthing switch contact (before and after mechanical endurance test)

v) Mechanical endurance test

vi) Short time withstand current and peak withstand current tests

vii) power frequency voltage tests on auxiliary switches at kV(rms) for one minute.

viii) Galvanization tests

ix) Chemical composition of contact material, springs and fasteners and bushes.

x) Physical tests on springs and fasteners and copper strips.

1.1.6 Type test report for operating motor carried out as per relevant ISS or BSS shall be required to be submitted for approval.

1.01.07 Temperature rise and breakage capacity tests reports for auxiliary equipments i.e., closing and trip coils, auxiliary contacts, limit switch etc., shall also be required to be submitted for approval.

1.02 ACCEPTANCE AND ROUTING TESTS:

1.02.01 All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in presence of purchaser's representative.

1.02.02 Mechanical operation tests (routine test) shall. be conducted on the complete disconnect (man switch and earth switch) at supplier's works and a certified test report be furnished to the purchaser. Alternatively the bidder may offer to conduct this test at purchaser's sub-station in which case the purchaser shall make necessary arrangement to erect the disconnect at his sub-station site under supervision of bidders representatives for supervision shall not be borne by the purchaser.

1.02.03 The test report of power frequency voltage withstand test conducted on the insulator shall be furnished for purchaser's acceptance in lieu of conducting the power frequency (dry) test on main circuit (routine test).

1.02.04 LIST OF ROUTING TESTS:

List. of routine test to be carried out as per IS : 9921, Part - IV - 1985 are as given below:

a) ISOLATORS

- Visual examination of components.
- Assembly, interchangeability and verification of critical dimensions.
- One minute power frequency voltage dry withstand tests across the isolating distance and to earth.
- Measurement of resistance of isolator contacts and between terminals of the main circuits.
- Power frequency voltage withstand tests on auxiliary and control circuits and auxiliary switches at 2 KV (rms) for one minute.
- Mechanical operation tests.

b) EARTHING SWITCHES

- Visual examination of components
- Assembly, interchangeability and verification of critical dimensions.
- Power frequency voltage withstand tests on auxiliary, and control circuits and auxiliary switches at 2KV (rms) for one minute.
- Mechanical operation tests.

Immediately after finalization of the programme of type / acceptance / routine testing, the supplier shall give three weeks advance intimation to the purchaser, to enable him to depute his representative for witnessing the tests.

1.04 SPECIAL TESTS

Special tests listed below shall be carried out in presence of purchaser's representative.

1) Test on insulators - Conforms to IS - 2544

2) Test on insulators - Conforms to IEC - 168

3) Test on terminal connecters – IS : 5561

4) Operation tests on operating mechanism and interlock - IS : 2623

5) Endurance test on Auxiliary switches.

1.05 Test certificates and documents of the following items shall be furnished at the time of routine tests.

- Chemical analysis of copper along with a copy of central excise certificate / gate pass indicating genuine source of procurement of electrolytic grade.
- Bearings
- Fasteners
- Universal/ swivel joint coupling.
- Insulators.
- Gears
- Auxiliary switch
- Interlocking devices.
- Terminal block

The purchaser may at his discretion request additional test certificates for other items as reasonably required to substantiate the quality of the same.

2.00 INSPECTION

The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser, shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the purchaser informed in advance, about the manufacturing programme so that arrangement can be made for inspection. The purchaser reserves the light to insist for witnessing the acceptance / routine testing of the bought out items.

3.00 DOCUMENTATION:

3.01 All drawings shall conform to International Standard Organization (ISO) ' A ' series of drawing sheet / Indian standards specification IS : 656. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in system international units.

3.02 **LIST OF DRAWINGS AND DOCUMENTS:**

The bidder shall furnish four sets of following drawings along with his offer:

a) General outline and assembly drawings of the disconnect, operating mechanism, structure insulator and terminal connector.
b) Sectional views and descriptive details of items such as moving blades, contacts arms, contact springs, contact support, turn and twist mechanism, bearing, housing of bearing, bushes, balancing of heights, phase coupling pipes, base plate, operating shaft, guides, swivel -joint operating mechanism and its components, etc.
c) Loading diagram.
d) Drawings with structure for the purpose of type test
e) Name plate
f) Schematic drawing
g) Type test reports in case the equipment has already been type tested
h) Test reports, literature, pamphlets of the bought out items and raw material.

3.03 The successful bidder shall, within four weeks of placement or order, submit three sets of final versions of all the above said drawings. The BWSSB shall communicate his comments on the drawings to the supplier. The supplier shall, if necessary, modify the drawings and resubmit three copies of the modified drawings within two weeks submit 10 prints and two good quality reproducible of the approved drawings on plastic coated (film type) durable reproducible paper for BWSSB's use.

3.04 Six sets of the type test reports, shall be submitted by the supplier for distribution, before commencement of supply, adequate copies of acceptance alid routine test certificates, shall accompany the dispatches consignment.

3.05 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier's risk.

3.06 Approval of drawings/ work by purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices.

3.07 **INSTRUCTION MANUALS**

Twenty - five copies of the erection, operation and maintenance manuals in English shall be supplied for each type of the disconnect one month prior to dispatch of the equipment. The manual shall be bound volume and shall contain all drawings and information required for erection, Operation and maintenance of the disconnect including but not limited to the following particulars.

- Marked erection prints identify the component parts of the disconnect as shipped with -assembly drawings.

- Detailed dimensions and description of all auxiliaries.

- Detailed views of the insulator stacks, metallics, operating mechanism, structure, interlocks, spare parts etc.

4.00 **PACKING AND FORWARDING:**

4.01 The equipment shall be packed in crates suitable for vertical / horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for damage to the equipment during the transit, due to improper and inadequate packing. The easily damageable materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.

4.2 Each consignment shall be accompanied by a detailed packing list containing the following information.

a) Name of the consignee.
b) Details of consignment.
c) Destination
d) Total weight of consignment
e) Sign showing upper / lower side of the crate.
f) Handling and unpacking instructions.
g) Bill of materials indicating contents of each package.
h) One set of approved drawings and manual.

4.3 The supplier shall ensure that the purchaser before dispatch approves the packing list and bill of material.

SECTION – 4(D): INSTRUMENT TRANSFORMERS

CLAUSE NO.	PARTICULARS
1.0	**GENERAL**
2.0	**CONSTRUCTION FEATURES**
3.0	**Current transformers**
4.0	**Voltage transformers**
5.0	**Terminal connectors**
6.0	**Tests**
7.0	**Spare parts**
8.0	**Parameters**
9.0	**Testing and commissioning**
10.	**Technical specifications forVoltage transformers**
Tables -IB	

1.0 **GENERAL**

1.1 Qualifying Requirements Please refer to Volume I, Section IFB.

1.2 The instrument transformers and a shall conform to the latest version of the standards specified below except to the extent explicitly modified in the specification and shall being accordance with the requirements in Section - 1 & 2.

Sl. No.	IS No.	Details
i)	IS-5/1978 (3 versions)	Colour of ready mixed paint and enamels
ii)	IEC-60044-1 or IS-2705	Current Transformers
iii)	IEC-60044-2 or IS - 3156	Voltage Transformer
iv)	IS-335/1983, IEC-296, BS-148	Specification new Insulating oil
v)	IS-1271/1958	Classification of insulating material for electrical machinery and apparatus in relation to their thermal stability in services.
vi)	FIS-1570 (Part-V)	Specification for Current Transformers
vii)	IS-2099/1985, IS-5621/1980	Bushing for alternating voltages above 1000 Volts
viii)	FIS-1705/1981	Specification for Current Transformers Part-1:General requirement Part-2:Measuring Current Transformers Part-3:Protective Current Transformers
ix)	IS-2932/1974	Enamel Synthetic interior (a) under coating (b) finishing
x)	IS-3024/1965	Electric steel sheet oriented with amendment No.1 and 2
xi)	IS-4253/1980 Part-II	Cork and rubber
xii)	IS-5561/1970	Electric power connectors
xiii)	IS-11322/1955	Method for partial discharge in instrument transformer
xiv)	IS-4201/1983	Application guide for Current Transformer

1.3 The instrument transformers shall be complete with its terminal box and a common marshalling box for a set of 3 instrument transformers.

1.4 The instrument transformer tank along with top metallics shall be hot dip galvanized or pained as per IS - 5 shade 697.

1.5 The impregnation details along with tests/checks to ensure successful completion of impregnation cycle shall be furnished for approval.

1.6 Bellows if used for expansions of transformer oil shall be tested in accordance with relevant standards. The details of the same to be furnished for approval.

1.7 Any deviation from this specification proposed by the tenderer calculated to improve upon the performance, utility and efficiency of the equipment will be given due consideration thereof are furnished. In such a case, the tenderer shall quote according to this specification and deviations, if any proposed by him shall be quoted as an alternative/alternatives. In any case of any contradiction between the provisions of the Indian Standards specification/recommendation of the IEC and this specification the latter shall prevail.

2.0 CONSTRUCTION FEATURES :

The features and constructional details of instrument transformer shall be in accordance with requirements stipulated hereunder :

2.1 Bushings/ Insulators :

a). Instrument transformers shall be of 66kV Class, oil filled, self-cooled with shielded porcelain bushings/ Insulators suitable for outdoor service and upright mounting on steel structures.

b). Bushing/Insulators shall conform to requirements stipulated in Section 2. The Bushing/ insulator for CT shall be one piece without any metallic flange joint.

c). Bushing shall be provided with oil filling and drain plugs oil sight glass for CT and electromagnetic unit for CVT etc., The bushing/ insulator of instrument transformer shall have a cantilever strength of not less than 350 Kg for 66KV Instrument transformers or as per the value obtained vide Section - 2 whichever is higher.

d) Instrument transformers shall be hermetically sealed units. Pressure relief device shall also be provided.Bidder/ Manufacturer shall furnish details of the arrangements made for the sealing of instrument transformers along with the bid. Bidder/ Manufacturer shall furnish the details, tests to check the effectiveness of hermetic sealing approval.

e). Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals; at the associated terminal block.

2.2 Terminal box / Marshalling box:

Marshalling box / terminal box shall conform to the requirements of Section - 2 General Technical Requirements Volume – II(A)

2.3 Insulating Oil :

Insulating oil to be used for instrument transformers shall conform to IS : 335, (required for first filling)

2.4 Name Plate:

Name plate shall conform to the requirements of IEC incorporating the year of manufacture. The rated current extended current rating in case of current transformers and rated voltage, voltage factor in case of voltage transformers shall be clearly indicated on the nameplate. The rated thermal current incase of CT shall also be marked on the nameplate.

The intermediate voltage in case of capacitor voltage transformer shall be indicated on the name plate.

3.0 CURRENT TRANSFORMERS:

a) Current transformers shall be of dead tank type have single primary either ring type, or hair pin type OR Live tank with Bar primary/ ring type and suitably designed for bringing out the secondary terminals in a weather proof (IP 55) terminal box at the bottom.

These secondary terminals shall be terminated to stud type of M6 size non disconnecting terminal blocks inside the terminals box.

b) Different ratios specified shall be achieved by secondary taps only without primary reconnection.

c) Core lamination shall be of cold rolled grain oriented silicon steel or other equivalent alloys. The cores used for protection shall produce undistorted secondary current under transient conditions at all ratios, with specified CT parameters.

d) The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.

e) Facilities shall be provided at terminal blocks in the marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals.

f) Current transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

g) For 72.5KV class CTs the rated extended primary current shall be 120% on all cores of the CTs specified in Section - 1.

h) For 72.5KV Current transformer, characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over a range of 10% to 100% of rated current in case of metering CTs and up to the accuracy limit factor/ knee point voltage in case of protection cores of CTs used for relay circuits.

i) The current transformers shall be suitable for horizontal transportation. It shall be ensured that the CT is able to withstand all the stresses imposed on it while transporting and there shall be no damage in transit. The Contractor shall submit the details of packing design to the BWSSB for review.

j) For 72.5KV CTs the instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs / reactors are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs / reactors shall preferably be in built construction of the CTs.

k) The wiring diagram plate for the interconnection of the three single phase CTs shall be provided inside the marshalling box.

l) The current transformers should be suitable for mounting on lattice support structure to be provided by the Contractor in accordance with stipulations of Clause 25.0 of Section - 2 (GTR) and Clause 1.1 of Section - 7.0 (Structure).

m) The CT shall, be designed as to achieve the minimum risks of explosion in service. Bidder/ Manufacturer shall, bring out in his offer, the measures taken to achieve this.

n) Normally no joints in the windings shall be allowed. Joints if unavoidable shall be brazed with high silver alloy grade Ba Cu AG 6 of IS-2927/1975 or/but welded.

o) The current transformer shall have a single core with wound primary. Super enameled wire shall preferably be used for secondary windings. COPPER CONDUCTOR shall be used for all windings.

4.0 LIMITS OF TEMPERATURE RISE:

4.1 Temperature rise of a Current Transformer winding when carrying a primary current equal to the rated continuous thermal current at a rated frequency and with rated burden shall not exceed the appropriate values given in the following table. The temperature rise of the windings is limited by the lowest class of insulation either of the winding itself or of the surrounding medium in which it is embedded.

TABLE OF TEMPERATURE RISE:

Class of Insulation	Max. Temperature rise in °C
All classes immersed in oil	60
All classes immersed in bituminous compound	50
Classes not immersed in oil or bituminous compound, Class-A	60

NOTE:

1. The Temperature rise permissible shall be based on an ambient temperature of 45°C.

2. Class-A insulation: Materials or combination of materials such as cotton, silk and paper when suitably impregnated or coated or when immersed in a dielectric liquid such as oil shall be used. Materials or combination of materials may be included in this class if by experience or by accepted tests they can be shown to be capable of operation at 105°C.

5.0 MARSHALLING BOX:

5.1 Outdoor weather proof Marshalling box shall be supplied with each set of C.Ts. (3 Nos.) in to which secondary leads from each phase and each core shall be brought and terminated. Arrangements for forming star/delta connection shall be made in this kiosk as also for ground connection. The kiosk should be weather and vermin proof and shall be suitable to mount the same near the C.Ts. Core details shall be clearly marked on the terminal blocks, which shall be capable of carrying the short time secondary current and also shall be capable of withstanding 4 kV. The terminal shall be of 8 mm nut and stud type made out of brass coated with nickel with two Nos. of flat brass washers nickel coated and spring washer. Number of terminals to be provided shall be as follows:

66 kV - 27 Terminals (9 terminals in vertical column 3 rows each)

Cable glands should be suitable for 4 Core PVC insulated, PVC sheathed 6/10 sq.mm. stranded copper cable. 9 Nos. cable glands for other C.Ts. shall be supplied fitted to the marshalling box.

The outdoor kiosk shall be supplied for 66 kV C.Ts.
Clearance between columns 150mm each from Base plate also terminals shall be at a height of 250mm.

6.0 TERMINAL CONNECTORS:

The terminal connectors shall meet the requirements as given in Section -1& 2.

7.0 **TYPE TESTS :**

7. 1 In accordance with the requirements in Clause 13 Section - 2 current and voltage transformers should have been type tested as per IEC/IS and shall be subjected to routine tests in accordance with IEC 60044-1/IS : 2705 & IEC 60044-2 / IS : 3156 respectively. The type tested equipments only shall be offered. The type test reports of not older than 5 years on the day of bid opening shall be furnished. The contractor/ supplier shall arrange for conducting all type tests in case type test reports are older than 5 years on the day of bid opening at no extra cost to BWSSB. However, the bidder shall quote the rates for all type tests individually in the schedule. The BWSSB at his discretion may require all or a few type tests, to be conducted again even though type test reports are less than 5 years old on the day of bid opening. In such cases the type test charges will be paid as per quoted rates in the schedule.

7.2 For72.5KV CTs and VTs following additional type tests are also proposed to be conducted, in additional to the other type tests as per IS & IEC in the relevant schedule.

a) Current Transformers :

1) Radio interference test - As per IS: 8263

2) Seismic withstand test (As per Annex - B of Section - 2)

3) Thermal stability test i.e., application of rated voltage and rated current simultaneously by synthetic test circuit.

4) Thermal co-efficient test i.e. measurement of tan delta as a function of temperature (at ambient and between 80º and 90ºC) and voltage (at 0.3, 0.7, 1.0 and 1. 1 Um/3)

b) Voltage transformers :

1) High frequency capacitance and equivalent series resistance measurement as per IEC60044-2 .

2) Seismic withstand test (as per Annex - B of Section -2)

3) Stray capacitance and stray conductance measurement of the low voltage terminal - As per IEC60044-2.

4) Determination of temperature co-efficient test (as per IEC60044-2)

7.3 **ROUNTINE TESTS**

The current and voltage transformers shall be subjected to the following routine/ site tests in addition to routine tests as per IEC/ IS.

a) **Current Transformers:**

Routine Tests :

1) Measurement of Capacitance
2) High voltage power frequency withstand test on Secondary Winding
3) Over voltage inter turn test - As per BS : 3938
4) Oil leakage test
5) Measurement of tan delta at 0.3, 0.7, 1.0 and 1. 1 Um/3
6) Measurement of partial discharge, as per IEC 44 - 1

Site Test :

Dissolved gas analysis to be carried out at the time of commissioning. CTs must have adequate provision for taking oil samples from the bottom of the CT without exposure to atmosphere. Bidder/ Manufacturer shall recommend the frequency at which oil samples should be taken and norms for various gases in oil after being in operation for different durations. Bidder/ Manufacturer should also indicate the total quantity of oil which can be withdrawn from, CT for gas analysis before refilling or further treatment of CT becomes necessary.

8.0 SPARE PARTS

The bidder shall include in his proposal spare parts in accordance with Section - 1 & 2.

9.0 PARAMETERS :

9.1 A) 72. 5kV Current Transformers

APPENDIX-3
Part 1 of 2
Technical Parameters of Current Transformers (Type & Rating)

Sl. No.	Technical Particulars	Type-3a	Type-3b	Type-3d
1	Normal System Voltage (KV)	66KV	66KV	66KV
2	Highest System Voltage (KV)	72.5KV	72.5KV	72.5KV
3	Frequency	50Hz	50Hz	50Hz
4	Earthing	Effective	Effective	Effective
5	Basic Insulation Level (KV Peak)	325	325	325
6	Power Frequency withstand strength (KV RMS)	140	140	140
7	Short Time Current rating (KA for 1 sec)	31.5	31.5	31.5
8.	Secondary winding current rating (Amp)	1	1	1
9	Number of ratios	3	3	3
10	Ratio	400-200/1-1-1A	200-100/1-1-1A	800-400/1-1-1A
11	Purpose for which used	66KV line using lynx / coyote & 31.5MVA Tr. & 66KV capacitor bank	Up to 20MVA 66/11KV Tr.	66KV lines usin Drake & 630 Sq. mm cable
12	Method of obtaining Secondary ratio	By secondary tapping without primary reconnection	By secondary tapping without primary reconnection	By secondary tapping without primary reconnection
13	Suitability of Bimetallic terminal connector	Drake ACSR (28.14mm Dia or 50mm Aluminium Tube)	Drake ACSR (28.14mm Dia or 50mm Aluminium Tube)	Drake ACSR (28.14mm Dia or 50mm Aluminium Tube)

Appendix-3
Part 2 of 2

Sl. No	Type of CT's	Purpose	Rated burden	Accuracy Class	Accuracy limit factor	Instrument security factor	Knee point volts (min) VK	Secondary winding resistance max. at 75^0C RCT	Magnetizing current
A	66KV CT Type-3a Core –1	Differential Scheme	--	PS	--	-	1600V at 400/1 A	4 Ohm at 400/1A	30mA at Vk/4
	Core –2	Metering	10VA	0.2	--	≤ 5 at all ratios	800V at 200/1 A	2 Ohm at 200/1A	30mA at Vk/4
	Core –3	Back	30VA	5P	20	--	--	--	--
B	66KV CT Type-3b Core –1	Differential Scheme	--	PS	--	-	800V at 200/1 A	2 Ohm at 200/1A	30mA at Vk/4
	Core –2	Metering	10VA	0.2	--	≤ 5 at all ratios	--	--	--
	Core –3	Back	30VA	5P	20	--	--	--	--
C	66KV CT Type-3d Core –1	Distance/ Differential Scheme	--	PS	--	-	1400V at 800/1 A	5 Ohm at 800/1A	30mA at Vk/4
	Core –2	Metering	10VA	0.2	--	≤ 5 at all ratios	--	--	--
	Core –3	Back	30VA	5P	20	--	--	--	--

10.0 TESTING & COMMISSIONING:

10.1 An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P/ Instructions of the equipment Supplier or BWSSB without any extra cost to the BWSSB. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the BWSSB for approval.

10.2 Current Transformer

a) Insulation Resistance Test for primary and secondary

b) Polarity test

c) Ratio identification test - checking of all ratios on all cores by primary injection of current.

d) Dielectric test of oil (wherever applicable)

e) Magnetizing characteristics test.

f) Tan delta and capacitance measurement

g) Secondary winding resistance measurement

TECHNICAL SPSCIFICATION FOR VOLTAGE TRANSFORMERS :

1.00 **SCOPE :**

1.01 This specification provides for design, manufacturer, inspection and testing before dispatch, packing and delivery FOR (Destination) testing and commissioning of electro- magnetic type outdoor voltage transformers along with all accessories specified herein for protection and metering services. The voltage class of VTs required are 66KV.

1.02 Following is the list of documents constituting this specification:

i) Technical specification
ii) Technical Data sheets

1.03 The voltage transformers, shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and BWSSB shall have the power to reject any work on material, which in his judgment is not in full accordance therewith.

2.0 STANDARDS:

2.1 Unless otherwise specified elsewhere in this specification, the voltage transformers shall conform to the latest revisions and amendments there-of of the following standards :

Sl No	Standard No	Title
1	IER : 1956	
2	IS : 5	Colours for paint and enamels
3	IEC : 44(4)	Voltage transformers-measurement of PDs
4	IEC : 60	High voltage testing techniques
5	IS : 104	Ready mixed paints and brushing
6	UEC : 171	Insulation coordination
7	IEC : 270	Partial discharge measurement
8	IS : 335	Insulating oil for transformers
9	IS : 649	Methods of testing of steel sheets for magnetic circuits and power electrical apparatus
10	IS : 2071(Part I to III)	Method of high voltage testing
11	IS : 2099	High voltage porcelain bushings
12	IS : 2147	Degree of protection provided by enclosures for low voltages, switchgear and control
13	IS : 2165	Insulation coordination for equipment of 110 KV and above
14	IS : 2927	Brazing alloys
15	IS : 3156	Voltage transformers
16	IS : 3024	Electrical steel sheets (oriented)
17	IS : 3134	Guide for selection of insulators in respect of polluted conditions
18	IS : 3347	Dimensions for porcelain for transformer bushings
19	IS : 5561	Electrical power connectors
20	IS : 5621	Hallow insulators for use in electrical equipments
21	IS : 6792	Determination of electrical strength of insulating coils
22	IEC : 8263	Method of RIV test on high voltage insulators

2.02 Equipment meeting with the requirements of other authoritative International Standards, which ensure equal or better performance that the standards mentioned above, shall also be considered. When the equipment offered by the supplier conforms to other standards, salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule. Two copies of such standards with authentic translation in English shall be furnished along with the offer.

3.00 **PRINCIPAL PARAMETERS:**

The Voltage Transformers covered in this specification shall meet the technical requirements listed hereunder:

Sl. No	**Item**	**72.5 KV**
1	Type / Installation	Single phase oil filled hermetically sealed outdoor type
2	Type of mounting	------ Pedestal Type ---------
3	Highest system frequency	72.5
4	Suitable for system frequency	-------- 50 Hz ----------
5	Voltage Ratio:	
	i) Rated primary voltage	66kV /√3
	ii) Secondary voltage (volts)	---------- 110V / √3 ---------
6	Method of earthing the system where the VT will be installed	----- Effectively earthed ----- (Solidly grounded)
7	1.2 / 50 microsecond lightning impulse withstand voltage (KVP)	325
8	1 minute dry power frequency withstand voltage primary (KV rms)	140
9	Minimum creepage distance of porcelain housing (mm)	1813
10	Rated voltage factor	---- 1.5 for 30 seconds --- 1.2 continuous
11	1 minute power frequency withstand voltage	
	i) Low voltage terminal (HF) and earth terminal (KV rms)	4 if the low voltage is exposed to weather
	ii) Withstand voltage for secondary winding (KV rms)	----- 2 --------
12	Max temperature rise over ambient of 50 deg C	---- As per IEC 86 -----
13	Rated total thermal burden	--- 300 VA ---for core I
		---- 200 VA ---for core II
		---- 50 VA --- for core III
14	No. of terminals in control cabinet	All contacts and control circuits to be wired up to control cabinet plus 20 % extra terminals exclusively for BWSSB's use.
15	Seismic acceleration (Horizontal)	------- 0.3 g -------
16	Standard reference voltage for which accuracies are valid	97% to 103% for protection 99% to 101% for metering

COREWISE DETAILS OF VOLTAGE TRANSFORMERS

Sl. No.	PARTICULARS	REQUIREMENTS
1	Rated primary voltage	72.5kV
2	Type	66kV / √3
3	No. of Secondary	------single phase VT -------
4	Rated voltage factor	-------- 1.2 continuous ------- --------- 1.5 for 30 seconds -----
5	Phase angle error	--------- + / - 20 minutes -------
6	Rated voltage (volts)	CORE – I 110V / √3
		CORE – II 110V / √3
		CORE – III 110V / √3
7	Application	Metering protection Open Delta protection
8	Accuracy	0.2 3P 3P
9	Output Burden	300VA 200VA 50VA

4.0 DEFINITIONS AND TERMINOLOGY:

In accordance with Clause 3.0 and sub-clauses there of as per IS : 3156 (part I to III) – 1998.

5.0 SERVICE CONDITIONS:

This shall be in accordance with Clause 4.0 and sub-classes thereof as per IS : 3156 (Part – I) – 1998 except for the Clauses 4.4 , 4.5 (a), 4.5 (b)4.5(c) (ii). However , the voltage transformers shall be suitable for tropical conditions and for atmospheres conductive to the growth of fungi and condensation of moisture. The VTs shall be suitable for installation in a solidly grounded system.

6.0 INSTALLATION REQUIREMENTS, TYPE AND CONSTRUCTION :

6.1 GENERAL :

The VTs shall be suitable for outdoor installation and for upright mounting on steel structures. The necessary flanges, bolts, etc.,

for the base of VT shall be supplied and these shall be galvanized.

6.02 They shall be of the oil immersed, self-cooled type and provided alternatively with an inert gas cushion or with metallic bellows above the-insulating oil level. A pressure relief device valve type may also be provided if permitted to design. The base shall be provided with suitable. welded M.S. Channels for bolting the VT in an upright position to the VT mounting structure.

6.03 DESIGN :

The VTs may be built up of high-grade non ageing cold rolled grain oriented silicon steel lamination, conforming to IS : 3024, of low hysterisis losses and high permeability to ensure high accuracy at both normal rated and above rated voltages. The laminations shall be coated on both sides with suitable insulation capable of withstanding stress relieve annealing. The cores shall meet with the requirements of the accuracy class, corresponding to the voltage factors in respect of the composite limits of accuracy as applicable for each type of core namely metering and protection.

6.04 INSULATING OIL

The oil shall be mineral insulating oil conforming to IS : 335-1983.

6.05 LIMITS OF TEMPERATURE RISE:

This shall be with reference to an ambient temperature of 45º C at specified rated frequency and at rated burden or at the highest rated burden connected to the secondary windings. The limits of temperatures rise shall not exceed the values specified in Table 3 of IS : 3156 (Part-1) 1998. However, if the voltage transformers has an inert gas cushion above the oil at the top of the tank or housing shall not exceed 50º C.

6.06 WINDING:

6.06.1 Primary Winding:

Primaries of Potential Transformers will be connected in phase of Neutral with the neutral point solidly earthed. The neutral of the system is also solidly earthed. The primary winding shall be of copper.

6.06.2 Secondary Winding:

Potential Transformers shall be provided with three secondary windings each rated for 63.5 Volts. Core-I will be used for

metering, Core-II for protection and Core-III for Open Delta. The secondary winding shall be of copper.

6.06.3 Normally no joints in the winding shall be allowed. Joints unavoidable shall be braized with high silver alloy grade of IS: 2927 or but welded.

6.07 BUSHING:

This shall be as per Clause 4.1 of IS : 3156 (Part-l)-1992. A prismatic oil sight gauge glass shall be provided on the top of the bushing metal assembly. The minimum creepage length of the bushing insulator/ hollow insulator shall be as follows:

123kV	3075 mm
72.5 kV	1813 mm
36 kV	900 mm

6.08 EARTHING:

Refer Earth mat specification, Volume - 11.

6.09 TERMINAL ARRANGEMENT:

6.09.1 Primary:

The primary bushing terminals shall be of the rigid type suitable for connection to an ACSR conductor through terminal connectors. The terminal shall be of tin plated copper, the connector shall be a bimetallic connector conforming to IS : 5561-1970 and shall be as per Clause 7.00 infra specified herein.

The HV neutral end terminal shall not be earthed directly to the metal body of the VT but shall be brought out through a porcelain 2 KV class bushing. Similarly an earth bushing, shall also be provided for connecting to the BWSSB's GI flat earth riser. A tinned copper link of the bolted type shall be provided to connect the HV neutral end terminal and the earth bushing. Both the HV neutral end bushing and the earth bushing shall be housed in a. dust tight, vermin proof box with a front access bolted type gasketted cover. This housing shall be on the opposite face of the secondary terminal box. The HV neutral terminal box shall be provided with caution plate indicating it is dangerous to open this link when the PT is charged. (Red colour)

6.09.2 Secondary :

The secondary terminals of the VT shall be housed in a dust tight, vermin proof box and with a front access gasketted cover.

The terminal box shall be of mild steel of thickness 3 mm. The terminals shall be made of brass and of the front projection stud type. The stud shall be provided with a locking checknut and other checknuts for securing the crimped terminals of external VT secondary cables. The bottom of the box shall be provided with nickel-plated cable glands to receive and support 2 x 6 sq mm PT secondary cables. The number of glands shall be equivalent to the number of secondary cores.

6.09.3 V.T. Marshalling Box:

A weather proof, vermin proof, outdoor type separately mounted marshalling box shall also be supplied and installed for each of the three phases, at the rate of one number for each set of 3 nos. of phase connected VTs. The marshalling box shall be of such size so as to accommodate three sets of vertically mounted terminal blocks. The secondary leads from each phase and core are to be connected to these terminal blocks for forming star or delta connection. The terminal blocks shall be of the cast resin moulded type capable of withstanding 2 KV for 1 (one) minute. The terminals shall be of the front projection brass stud and nut type provided with locking checkouts and with hexagonal nuts, flat spring washers for securing the crimped conductor lugs of external cables. Insulated cast resin barriers shall also be provided in between the different terminals in the terminal block. Each terminal block shall contain 9 (nine) numbers of terminals. 9 Nos. of terminals in each column x 3 columns for each core 1, core 2, core 3 with minimum of 150mm space between each column to facilitate wiring.

Bottom of the each column should be atleast 250mm above the base plate /Glanding plate to facilitate to pull the cable for connection. Terminal Bolt / stud type Brass coated with nickel, along with flat washers / spring washers of Brass coated with nickel size not less than 8mm. The box shall be provided with a front access gasketted cover and an earthing stud. The cover shall be of the bolted type. The earthing stud shall be provided with brass locking checknuts both on tile inside and outside and with brass nuts, flat and spring washers. The bottom plate of the box shall be provided with 3 (three) Nos. of cable glands suitable to receive 2 x 3 sq mm VT secondary control cables. The terminals shall preferably be shrouded with transparent plastic covers.

The top of the box shall be provided with 3 (three) Nos. of 25 mm circular dummy plates for fixing PVC/G l pipes for leading in the secondary lead wires or cables from the VT secondary terminals of each individual VT. The kiosk shall be painted both on the inside and outside with two coats of grey enameled paint as per Clause 8.00 infra

7.00 PRIMARY TERMINAL CONECTOR:

7.01 The connection shall be a rigid bimetallic connector suitable for receiving ACSR conductor as follows

72.5 KV DRAKE ACSR of all diameter 28.14 mm / LYNX ACSR of overall diameter 19.53mm

7.02 The connector shall conform in all respects to Clauses (4),(5),(6),(7), (8) and sub-clauses thereof as per IS : 5561-1970. The connector shall also be etched with the name of the ACSR conductor, which it shall receive.

7.03 The rating of the connector shall be as follows

Rated current 400Amps

Rated frequency 50 Hz

Rated short time current 31.5 KA for 72.5KV

8.00 PAINTING:

All metal surfaces in contact with insulating oil shall be painted with heat resistant paint insoluble to oil and insulating varnish. The pre-painting procedure shall consist of sand blasting, de-rusting, phosphating and priming of both the exterior and interiors in accordance with IS : 6005 - 1970.

9.00 MARKING

Every VT shall have the markings conforming to Clause 7.0 and sub clauses thereof as per IS : 3156 (Part - I) and (Part -II) - 19992 and clause 9.0 and sub - clauses thereof as per IS : 3156 (Part – III) - 1992.

10.00 **TESTS:**

10.0 1 Classification:

This shall be as per clause 9.0 and sub-clauses thereof as per IS: 3156 (Part-I) - 1992.

10. 0 2 Type Tests :

This shall be in accordance with clauses 8. 1. 1 as per IS : 3156 (Part-I) 1992; 8.1 of IS : 3156 (Pa-it - 11) - 1992, Clause 9.0 of IS: 3156

(Part - II) - 1992. The type tested equipments only to be offered. The type test reports not older than 5 years on day of bid opening shall be produced, otherwise type tests shall be conducted at no extra cost to BWSSB.

10.03 Routine Tests :

The shall be as per Clause 9.12 IS : 3156 (Part - I) - 1992, 9.0 of IS : 3156 (Part - II) - 1978, Clause 9.2 of IS : 3156 (Part - III) - 1992.

10.04 Special Tests

This shall be as per Clause 9.1.3 (a) only as per IS: 3156 (Part - I) 1992.

10.05 Routine Tests and Test Reports

All routine and acceptance tests shall be conducted in the presence of BWSSB's representative. All test reports shall be got approved from the BWSSB. No dispatches shall be effected without approval to the test certificates.

10.06 Inspection

A representative of the BWSSB shall have free access at all times to inspect the manufacturer's work and to witness the tests.